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COMPOSTING:

INTRODUCTORY PROFILES

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Prepared by:
Division of Solid Waste
June 1987

Department of Environmental Quality Engineering

Commonwealth of Massachusetts

AGRICULTURAL, SLUDGE, AND SOLID WASTE COMPOSTING: INTRODUCTORY PROFILES

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INTRODUCTION

When any municipality considers composting its solid waste, the inevitable question is, "Who else is doing it?" This report was compiled to answer that question. It describes a number of operating agricultural, sludge and mixed solid waste composting projects in the United States, with an emphasis on New England and areas with similarly wet climates. Leaf and yard waste composting projects are dealt with in a separate report, Municipal Leaf and Yard Waste Composting -- A Selection of Case Studies, produced by Ferrand and Scheinberg Associates under contract to the Division of Solid Waste.

The projects profiled here were selected to show a representative range of technologies, end-uses for the compost, and design constraints. They range from very small-scale rural demonstration projects to large, fully-mechanized facilities in urban areas. Contact names are provided with each description for further information and to arrange site visits.

AGRICULTURAL COMPOSTING

Agricultural composting generally refers to the composting of animal manures with bulking agents such as hay, bedding, leaves, brush, food waste or shredded paper. A growing number of farms, nurseries and entrepreneurs in New England are finding composting appealing for a variety of reasons. For some, it is simply an environmentally sound way to handle and dispose of manure. Others seek an inexpensive material to condition their soil, provide nutrients, and reduce their dependence on fertilizers. Nurseries may use compost on their fields and in their potting mixes, and farmers have found that compost improves their crop yield and the quality and shelf-life of their produce.

Another incentive for composting is its income potential. Some entrepreneurs sell their product, either bagged or in bulk, to residents, town highway and public works departments, contractors and landscapers. A number of them specialize in high-quality bagged compost for the retail market. On the other hand, many operations do not market their product, but make money by taking in organic wastes from residents and local businesses, charging a tipping fee which is competitive with area disposal facilities.

Methods for agricultural composting vary widely. Generally, the higher quality compost desired, the more managed the method and the more equipment involved. Some farmers find that uncured, partially decomposed material may be adequate for their purposes. However, unfinished compost may contain ammonia, which creates offensive odors. Unfinished compost will also rob plants of available soil nitrogen, rather than add it.

Many farmers use windrows (elongated piles) which are turned mechanically. A smaller number of compost operators use static piles which are aerated by blowers and pipes. Off-the-shelf equipment can often be adapted for composting, but a farmer with some capital may buy a dedicated windrow turning machine and install a concrete pad or manure holding facilities.

Ipswich, Mass. (Appleton Farms)

Appleton Farms, established in 1646, is the oldest continually operating dairy farm in the country. James Geiger, general manager, says Appleton began composting to diversify its products and services, and that composting fits very naturally into the farm's operations.

The DEQE Division of Solid Waste sponsored a pilot project at Appleton Farms in 1986. The pilot tested different combinations of cow and chicken manure, crab shells, seaweed, shredded paper and yard waste, with laboratory analyses conducted on each product. The pilots also evaluated windrowing equipment and tested the use of ordinary farm machinery for paper shredding.

The raw materials come either from the farm's operations, or are dropped off for free by neighbors at either end of the property. Horse manure comes from local stables; crabshells are provided by fish processing industries; and the town public works department brings truckloads of seaweed from the beaches. The materials are placed in three separate windrows which are later combined: one with crabshells and horse manure; another with seaweed and horse manure, and a third with cow and horse manure. Composting time is about two months with an additional six months of curing.

A Wildcat windrow turner, attached to a tractor, turns the windrows once a week. Geiger purchased the turner for about $17,000 and traded in his old tractor for his current one, which has a "creeper gear" allowing it to move along at less than one m.p.h. Geiger says the creeper gear is essential for operating the turner. Other equipment includes tractors, a dump truck and a front end loader for mixing.

About half the compost is applied to the fields, saving on fertilizer costs. The rest is sold in one to five cubic yard loads to nurseries and home gardeners (at $52/yard or $64/yard with delivery). Geiger reports a strong market. Eventually he may bag the compost, although when this was tried in the past it became too moist.

Contact:

James Geiger, General Manager
Appleton Farms
P.O. Box 72
Ipswich, MA
(617) 356-2256

Appleton Farms (Ipswich, Mass.) composts cow and horse manure, crabshells and seaweed, using a Wildcat windrowing machine for aeration. (Courtesy Mass. Dept. of Food and Agriculture)

Hopkinton, Mass. (Weston Nurseries, Inc.)

Weston Nurseries is a wholesaler and retailer of nursery stock. It has a 550-acre farm and grows one of the largest varieties of landscape-size plants delivered throughout New York, New Jersey and New England. It also runs a garden center and designs and installs landscaping.

The nursery utilizes a variety of animal manures and composts them in piles with bedding and woodchips from local sawmills. The piles are not frequently turned, since the nursery has found semi-decomposed materials to be adequate for their purposes. The product is used in the fields to replace soil that is removed when trees and plants are dug up for sale, and as a nutrient source.

In addition, Weston Nurseries takes in leaf and yard waste from Hopkinton and the nearby communities of Framingham, Natick, Milford and Wellesley. Most of the actual composting is done in the towns, so that the leaves' bulk density is increased, reducing transportation costs. The nursery sends a truck over to turn the leaves about three times a year and pick up the finished product. The nursery uses the leaf compost in its potting mix, but does not sell it. At the moment, it pays a token fee for the leaves, but this is expected to change as municipal waste disposal fees rise.

Mezitt says the composting operation is expensive and costs more than it saves, because of trucking costs and fees he presently pays for the leaves and manure. Costs are $10-15/cubic yard. Fertilizers are still needed, although Mezitt says the compost makes the fertilizer more efficient. They continue to compost because the product improves the soil and seems to improve the quality of their plants. They are now evaluating their operation and considering whether to buy new equipment.

Contact:

Wayne Mezitt
Weston Nurseries
Route 135 (East Main Street)
Hopkinton, MA or

P.O. Box 186
Hopkinton, MA 01748
(617) 453-3414 or (617) 235-3431 (Boston)

Hamilton and Merrimac, Mass. (Agresource, Inc.)

Agresource is a contract composting company which accepts sludges, food and agricultural wastes at its operating farms in Hamilton and Merrimac. The basis of its business is cost avoidance for municipalities and businesses who would otherwise pay higher fees at landfills or incineration plants. Other regional cooperating farms in New England are planned.

As of Spring, 1987, Agresource was charging waste generators $15-$40 per cubic yard, depending on the material. If the compost is sold, company policy is to share the revenues with the generator 50/50; otherwise, compost is applied on the fields of cooperating farms.

Currently, Agresource composts several thousand cubic yards per year of sludge from North Shore communities with animal bedding. Other clients include a food processing company and a fish processing company. Food byproducts and fish wastes that would otherwise go to landfills or wastewater treatment plants are composted with a suitable carbonaceous material such as horse bedding or animal manure.

The materials are pre-mixed on receipt using a bucket loader on a cement pad until the desired moisture content is achieved. Windrows are then formed directly on suitable fields, and turned with a Wildcat windrowing machine. No woodchips are currently used, making screening unnecessary. Odor control has not been a problem, and there is a buffer zone around each facility.

According to Peter Britton, Agricultural Applications Manager, materials to be composted are analyzed in an independent lab before and after composting. Much of the compost is utilized on site for growing hay and to build up the soil. Agresource plans ~~a bulk~~ product line including soil amendments and conditioners, but some municipal clients want the material returned for landfill revegetation.

Contact:

Nathan Tufts, President and Marketing Manager (617) 346-9286
Peter Britton, Agricultural Applications Manager (617) 468-2733
Agresource, Inc.
101 River Road
Merrimac, MA 01860

Agresource, Inc. (Merrimac and Hamilton, Mass.) uses a Wildcat composter to turn and aerate municipal and commercial food sludges on one of its cooperating farms.

Edgartown, Mass. (Seaside Dairy)

The Division of Solid Waste and the Department of Food and Agriculture last year co-sponsored several pilot projects at Seaside Dairy on Martha's Vineyard. Although composting has been suspended during a change of ownership, there is a potential to charge a competitive tipping fee for taking in selected organic materials. The Vineyard is expected to pay up to $100/ton to ship its trash off the island once its landfills close.

Like many farms on Martha's Vineyard, the farm had a problem with manure. Manure piles draw odor complaints from neighbors and summer guests, but more important, runoff from the piles posed a threat to the underlying aquifer, the island's sole source of drinking water.

A series of windrows were set up to test combinations of cow manure with different bulking agents, including shredded and unshredded paper and cardboard, leaves and yard waste. The pilot also experimented with different mixing, turning and shredding systems to demonstrate that composting is possible without a big investment in equipment.

In one pilot, manure and various bulking agents were put in piles aerated with blowers to determine whether the farm could avoid having to turn them. It was found that when leaves or shredded paper were used, the piles would "collapse" when wet and not receive sufficient oxygen. Woodchips were more effective, but were found too expensive to purchase, mix and screen. Other tests used a bucket loader and a Wildcat windrowing machine to turn the windrows. A chopper already owned by the farm was used to shred paper and cardboard.

Cardboard (with some paper) proved the most effective bulking agent, while solving a major disposal problem (as much as 60 percent of the island's solid waste consists of cardboard packaging). The Wildcat windrow turner was favored because it could turn, shred and mix the materials, cutting down on labor and reducing the need to buy specialized equipment.

Contact:

Bill Wilcox
Dukes Cooperative Extension
Box 1696
Oak Bluffs MA 02557
(617) 693-0694

Bruce Fulford
New Alchemy Institute
237 Hatchville Road
East Falmouth, MA 02536
(617) 563-2655

Saratoga Springs, New York (Saratoga Raceway)

After grappling with the problem of horse manure disposal for over 20 years, this racetrack now transforms manure and bedding from 1,100 horses into a sought-after fertilizer and soil conditioner. Saratoga Raceway has been composting since the late 1970s, and in 1984 built a full-scale composting facility.

Manure and bedding are transported from the stables daily into a compost building with 11 concrete bays. Each bay can hold two day's worth of manure. When a bay is filled, blowers are turned on to pull ambient air through the materials. Temperature is monitored and closely controlled. After 21 days, the bay is emptied by means of a wheel loader. The compost, reduced to two-thirds its original volume, is piled, allowed to air cool for another 14 days, and shredded.

Saratoga's system yields about 50,000 cubic yards of finished product per year. The compost is mixed with additives and sold as compost, mulch or topsoil under the name "Saratoga Organic." It is not marketed as a fertilizer. Customers include area nurseries, the state Department of Environmental Conservation, the Bureau of Soil Management, the U.S. Department of Agriculture and gardeners as far away as New York City and New England.

Capital expenditures were about $225,000, over a period of 20 years. Saratoga estimates that costs to duplicate the system today are about $369,000, including containers, a compactor truck, a concrete compost building and bays, blowers, piping, a bagging plant and a shredder. At Saratoga, a single employee hauls the manure and runs the composting operation.

Previously, Saratoga Raceway spent up to $100,000 per year to dispose of its manure. Today, it is receiving queries from racetracks and horse farms all over the country and is marketing -- for $10,000 -- an information package telling how to duplicate its system.

Contact:

Robert W. Morris, Superintendent of Properties
Saratoga Harness Racing, Inc.
P.O. Box 356
Saratoga Springs, NY 12866
(518) 584-2110

Brookhaven, New York (Metski Enterprises)

Metski Enterprises is a family business which supplies sand, gravel and topsoil to contractors. It has been composting trees and stumps with duck manure for about a year and a half and took in approximately 150,000 cubic yards of materials in its first year.

Trees are brought in by local contractors, who avoid a tipping fee of $7.50/cubic yard at the Brookhaven landfill (Metski currently charges $6.50). Duck manure, a major disposal problem for the area's many duck farms, is accepted free of charge.

The operation is drawing attention as an alternative to landfilling and has been observed by the state Department of Environmental Conservation. The state has ordered the Brookhaven landfill closed by 1990, and alternative disposal space is becoming scarce. Metski also takes trees and stumps from neighboring towns whose landfills no longer accept them.

Operations take place on 50 acres of industrially-zoned land. Equipment alone cost $1.4 million, and includes a shear, a shredder, a backhoe, a tree chipper and two screening assemblies. The wood is then shredded, combined with the manure and formed into windrows, which are periodically turned by payloaders and monitored for temperature.

The composting process takes six to nine months and requires three full-time operators. The end product is screened, chemically tested and sold in bulk to local landscapers and greenhouses as compost or topsoil.

Contact:

Lorraine Metski
Metski Enterprises
181 Frowein Road
East Moriches, NY 11940
(516) 878-0652
(516) 878-1020

At the Metski Enterprises (Brookhaven, N.Y.) composting operation, trees are pre-cut by a La Bounty shear prior to shredding. The shredded wood is combined with duck manure and formed into windrows (seen in the background). Below, large stumps are reduced to a coarse, shredded material.

Northfield, Minnesota (Holden Farms, Inc.)

Holden Farms is a third-generation family-run farm in southeastern Minnesota. In 1980 it established a Resource Recovery Division, a private enterprise, to produce and market compost, and in 1987 won the Governor's Award for Excellence in Total Waste Management.

The farm composts about 55 tons per day of hog and turkey manure, using a windrow system, and markets two products: Agri-Brand Compost, an agricultural product, and Horticultural Grade Compost. The products are sold in bulk, generally in 100-ton minimum orders, to such customers as the University of Minnesota, Pillsbury Green Giant, a large nursery, Minnesota's largest winery and vineyard and many individual farmers. A local township uses the horticultural grade compost to replace topsoil in a road construction project.

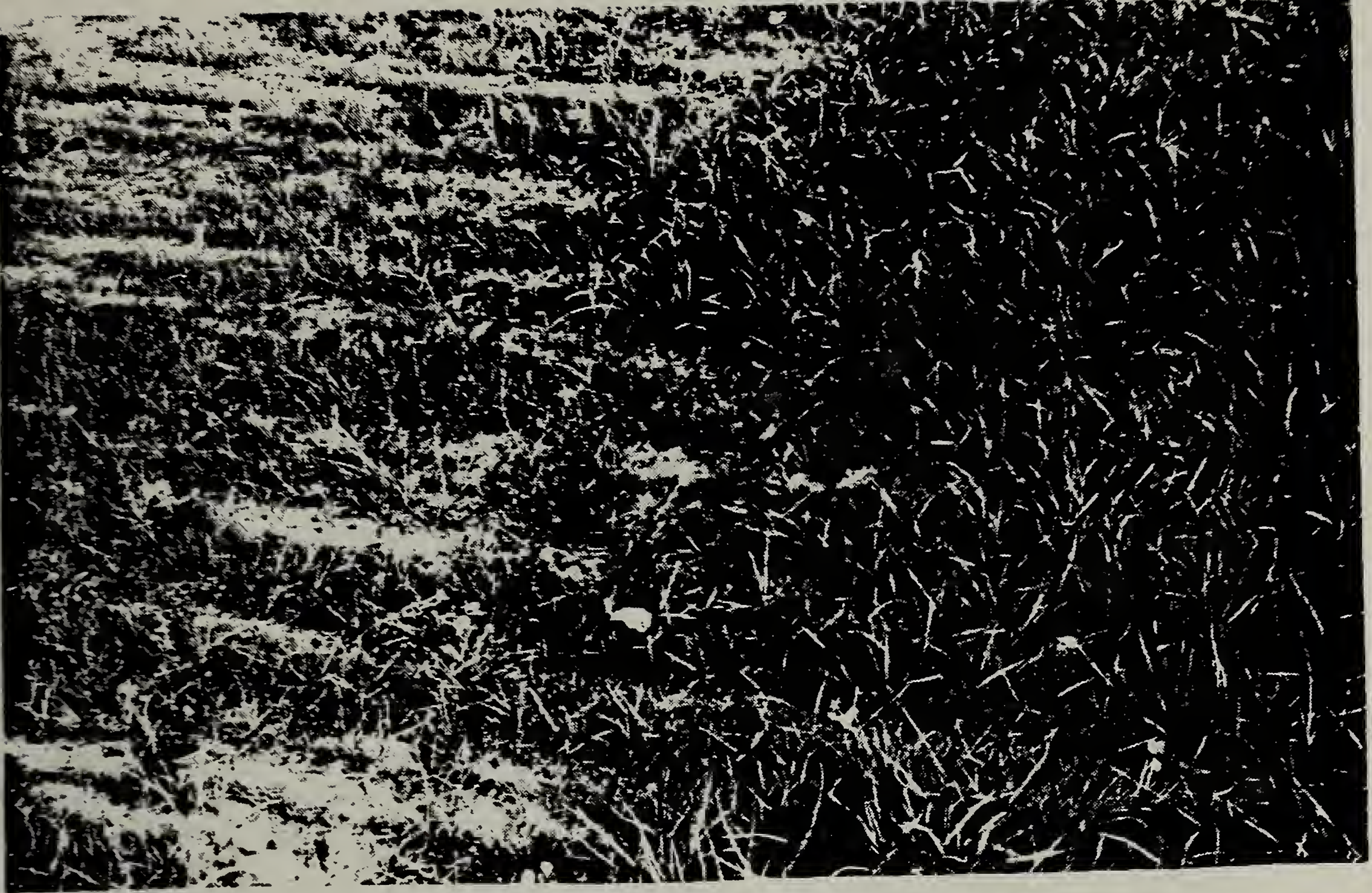
Holden maintains seven regional compost distribution centers and fleets of delivery trucks and application equipment. In addition to composting its own manures, Holden provides waste management services to over 30 poultry farms and feed lots at ten composting sites.

Because of state law, Holden cannot call its products fertilizers, and instead markets them as soil amendments and long-term soil builders. Each batch is sampled and priced based on its nitrogen: phosphorus: potash value. Since 1980, Holden has conducted tests comparing its compost with traditional fertilizers and soil amendments, and found increased yields in corn, wheat, snap bean and soybean crops. The farm has also tested landscaping and horticultural applications and studied the long-term benefits of compost on the soil. Its extensive findings appear in a 1986 report.

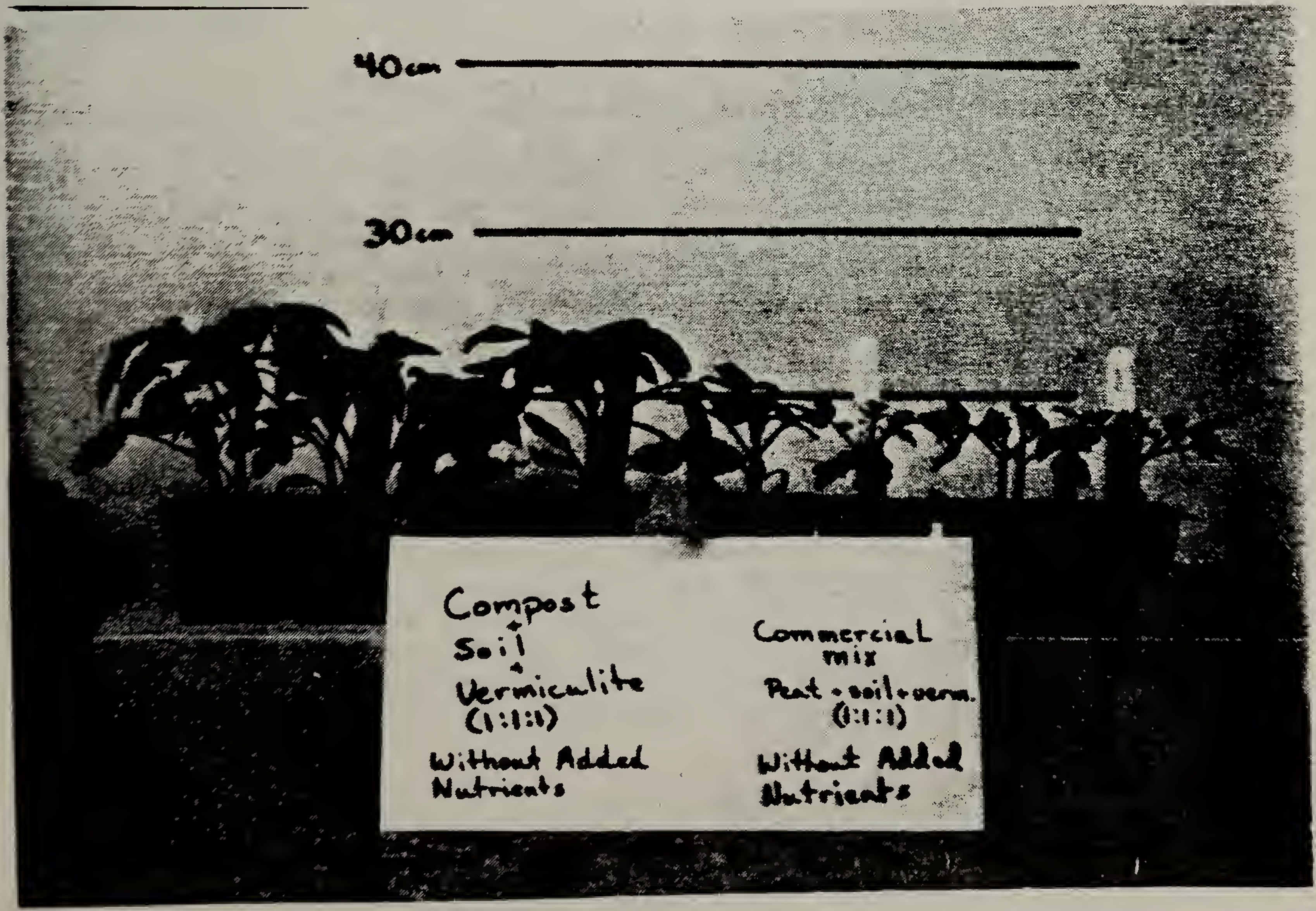
Contact:

Craig Holden
Resource Recovery Division
Holden Farms
Northfield, MN 55057
(507) 645-9371

For more information: Biocycle, April 1985; New Farm Magazine, July/August 1985.



Holden Farms (Northfield, Minn.) tests its compost on food crops, turf and landscaping applications. Above, Kentucky bluegrass grown in hypum peat plus fertilizer (left) and Holden Farms Horticultural Compost (right). Below, tomato plants grown in a compost mix (left) versus commercial potting soil (right).



SLUDGE COMPOSTING

Sludge composting has long been popular in Europe and Asia. It began in the United States in 1975 with the introduction of the "Beltsville method." For many communities, composting sludge is proving more cost effective than land application or incineration. According to a December 1986 survey by Biocycle magazine, there are 89 operational sludge composting facilities in the U.S., with many more planned or under construction. Massachusetts alone has two operating sludge facilities, two pilot projects, and 17 facilities in the planning, bid or design stages -- more than any other state.

Sludge composting requires a carbonaceous bulking agent to increase airflow in the mixture and absorb moisture. Sawdust, woodchips and recycled compost are common bulking agents; others include leaves, bark chips, shredded newsprint, rice, peanut hulls or corncobs. Most systems using woodchips have a process to recover and reuse them, since they often are a major operating expense.

Most current systems are of the static-pile type, in which the sludge is mixed with a bulking agent, formed into piles and aerated by perforated pipes and a system of blowers. After a retention period, which can vary, the compost may be cured and screened. The piles should be on a concrete pad with a gravel or wood chip base, and should ideally be enclosed or under a shelter of some kind.

Most aerated-pile facilities use the Beltsville process, developed by the U.S. Department of Agriculture. In recent years, Rutgers University has refined the process through a number of design changes. Some facilities have converted to the new method, known as the Rutgers Strategy. There are many differences between the two, but essentially, the Rutgers Strategy achieves faster and more complete decomposition through temperature control and improved ventilation. [For a detailed comparison, see the U.S. EPA Project Summary, "The Rutgers Strategy for Composting: Process Design and Control," EPA/600/S2-85/059, July 1985.]

A growing number of enclosed, mechanized "in-vessel" composting systems are appearing on the market. Because they are enclosed, vessel systems are generally easier to site, require less land area and potentially have better odor control. They may also offer more control over the decomposition process. However, maintenance costs may be high for some of the more complex systems. For small communities which cannot pay the high capital costs, or cannot afford hauling sludge to a regional site, small-scale windrow or aerated-pile systems are the better choice.

The major technical problems in sludge composting are odor control, adjusting to varying sludge characteristics, and control of moisture content (excessive moisture can make compost difficult to mix and screen).

Composted sludge should be thoroughly tested for heavy metals and toxins. It is generally not recommended for agricultural use or on vegetable gardens, even when made from very "clean" domestic sludge from a residential area. It is often used on municipal parks, highways and as landfill cover. When sold, markets include landscapers, nurseries, golf courses, and homeowners.

Williamstown, Mass. (Hoosac Water Quality District)

The Hoosac Water Quality District operates a sludge composting facility serving North Adams, Williamstown, and parts of Clarksburg, a population of about 28,300. The system started up in December, 1983.

A fairly wet sludge is combined with two to three parts of woodchips in a mixing truck, and loaded into one of eight unenclosed concrete chambers. The chambers are used because of limited space; only about an acre is available for composting. There is a leachate and air supply line at the bottom of each. The mixture remains in the chamber for 25-40 days, or until they need to make room for incoming sludge. If the compost is not dry enough to screen at that point, it is placed in a curing area.

The operator says that system can be run as either a negative or positive pressure system, because the airflow direction is reversible. The blowers may be controlled by either a timer or a temperature feedback system. The facility has had some problems with odors, which tend to blow down the adjacent Hoosac River, and has applied for a state grant to install an odor control system. They are now using a liquid odor-control chemical, with poor results. The District also hopes to get sludge dewatering equipment to obtain a drier raw material. This would save on woodchips, a major operating cost.

The end product is used as final landfill cover in Williamstown and North Adams. Some unscreened compost is used as intermediate cover. Because the compost is relatively high in heavy metals, its uses are restricted.

Contact:

George Heisler, Chief Operator
Hoosac Water Quality District
Simonds Road
P.O. Box 172
Williamstown, MA 01267
413-458-8423, 458-5016

Swampscott, Mass. (Swampscott Dept. of Public Works)

Until 1974, the Town of Swampscott, population 16,000, simply dumped its sewage out to sea. The town built a sewage treatment plant and at first incinerated the sludge generated. But with rising energy costs, the Public Works Department conducted an economic analysis and decided composting would be more cost-effective. At the time there were no community-wide sludge composting projects in the state.

The Town has now been composting for about seven years, using the Beltsville method. It composts about one ton per day of dry sewage sludge, combined with four parts of woodchips. Unlike many composting operations, Swampscott gets its chips for free from local tree surgeons. Leaves brought in by gardeners are also sometimes composted in separate piles.

A front end loader mixes the sludge and woodchips and forms static piles atop a six-inch base of woodchips. An automatic timer turns the air blowers on and off at 15-minute intervals. The loader also does some turning as it adds new sludge to the pile. After 25-30 days, the composted sludge is put in a holding pile for 30 days and then screened.

Samples are sent to a lab to test for pathogens, but not metals. According to the superintendent of public works, Swampscott's sludge is purely domestic. The compost is used by the DPW as a soil stabilizer on parks, grass strips, monuments, soccer fields and a local cemetary. Initially, it had been sold to the public, but interest seems to be declining. It is not recommended for vegetable gardens.

Contact:

Robert Sotiros, Superintendent
Department of Public Works
Town of Swampscott
22 Monument Avenue
Swampscott, MA 01907
(617) 581-7500

Durham, New Hampshire (Town of Durham)

The Town of Durham has been composting sludge for about 14 years on the site of its wastewater treatment plant. The plant produces about seven tons of dewatered sludge per day. The composting operation, one of the oldest in the country, is active four days a week.

Woodchips are mixed with the sludge in a 3:1 ratio, and the mixture is put in aerated piles. There is space on the site to accommodate eight piles. The piles are covered with a generous layer of woodchips to shelter them from rain and filter odors. Each contains a temperature probe which is checked daily. The air blowers run on a fixed schedule and can be reversed to either blow or draw air through the piles. Leachate is collected and run through the wastewater treatment plant. The operator says there is no odor problem, even without odor scrubbers.

After 21 days, the compost is screened to recover the woodchips, but is not cured. According to the operator, it is a high-quality product popular with residents, who pick it up for free for use in their gardens. The town has the compost tested twice a year for heavy metals, and although metal content is generally minimal, the product is not recommended for vegetable gardens.

Contact:

Michael Martin, Lab Technician
Durham Wastewater Treatment and Composting Facility
13 Newmarket Road
Durham, NH 03824
(603) 868-2274

Lebanon, Conn. (International Process Systems)

International Process Systems (IPS) operates a fully enclosed, fully automatic vessel composting system based on a Japanese technology. Since January, 1986, it has composted various animal manures to produce a line of high-quality, attractively packaged products which retail throughout New England. It is now seeking to expand its operations by composting other types of waste, and has run tests with commercial wastes including cranberry, apple, chocolate and pharmaceutical wastes. Because its system is modular, it lends itself well to small demonstration projects.

In the IPS process, wastes are loaded into a series of long concrete bays enclosed in a building. Each bay can process four tons of waste per day. A programmable agitator/mixer machine moves along the bays to aerate and mix the material and push it down the length of the bay. Because the wastes are so thoroughly agitated, IPS can compost sludge using sawdust as a bulking agent, saving the expense of woodchips.

A series of blowers aerate the compost, controlled by timers or automatic temperature feedback. Odors are pumped out of the building and through a soil filter. The composting process takes about 18 days.

IPS is seeking to establish itself as a sludge composting vendor, and in fall, 1986, the towns of Groton, Killingly, Norwich, Windham and New London, Conn. agreed to participate in a

The International Process Systems facility in Lebanon, Conn. composts sludge, manures and food processing wastes with sawdust in four long concrete bays. A programmable machine moves along the length of each bay to mix and aerate the materials.

one-month demonstration project. The towns brought over 100 tons of different types of sludge to the facility. The sludge was placed in one of the bays and mixed with sawdust and a blend of leaves and chips. The data from the pilot will be used in designing a regional composting facility for eastern Connecticut communities. The facility would charge a tipping fee competitive with area resource recovery plants.

Contact:

Geoffrey A. Kuter Ph.D.
International Process Systems
Lebanon, CT 06249
(203) 642-6670

Greenwich, Conn. (Greenwich Dept. of Public Works)

The Town of Greenwich, population 60,000, has been composting sewage sludge with compacted and ground leaves for approximately seven years. The composting operation covers two to three acres at the town's transfer station, and during 1985-1986 saved the town $300,000 in avoided disposal fees.

The leaves serve as a bulking agent, eliminating the need for woodchips. Some 20,000 cubic yards of leaves are collected by the town Highway Division in vacuum trucks and delivered in compacted form. Another 10,000 cubic yards are brought by private landscapers who collect leaves from streets, golf courses, and as a service to residents. Bagged leaves are not accepted at the facility.

Ordinarily, the town classifies leaves as bulky waste and charges a disposal fee of $48/ton. But leaves are accepted free of charge if they are separated from the rest of the waste. By diverting leaves, the town itself avoids a $33/ton tipping fee at a nearby landfill.

The leaves are ground in a hammermill. A front-end loader combines leaves, sludge and treated residue from the town's road drainage system on a paved mixing pad (the sludge:leaf ratio is approximately 1:46). The mixture is placed in aerated windrows which are broken down at least once during the two to three month composting process. Each compost pile is tested by the town Health Department. The compost is sold to citizens and landscapers with a written disclaimer saying that it is for landscaping purposes only. If screened, the price is slightly higher.

After initial problems with odors, the town installed more powerful blowers to provide better aeration. Although the site is very close to an expensive residential area, there has been only one minor odor complaint in the past three years.

Contact:

Ray Veillitte, Asst. Commissioner
Department of Public Works
Engineering Division
Town Hall - Field Point Road
Greenwich, CT 06830
203-622-7767

Sussex County, New Jersey (Sussex County Municipal Utilities Authority)

This project is often cited as a good example of a transition from the Beltsville method to the Rutgers Strategy.

The original Beltsville system began in 1984 under federal, state and county grants. Problems soon emerged: the material would not dry adequately; temperatures varied widely and sometimes went too high, killing the active bacteria; and the compost never stabilized and would reheat when stored. Because the material didn't dry, it was very difficult to screen out the wood chips. And there were severe odors. The site is next to a tributary, and odors concentrated and travelled along the valley.

In 1985, Rutgers University set up several on-site studies implementing the Rutgers Strategy. Modifications included adding more blowers and blowing air through the piles rather than drawing it in, to help remove excess heat and promote drying. Instead of a timer, the blowers were activated by a temperature feedback control, providing aeration as needed. As a result of these changes, the product is more stable and odors are substantially reduced.

Later improvements included enclosing the piles in metal buildings with fans and curtains, and modifying the aeration system to provide independent blowers and controls for different sections of each pile. Each aeration system has a temperature probe, from which a computer records data at five-minute intervals and plots it on a graph. The computers run the blowers first in "timer mode," then "temperature-feedback mode," and finally run them continuously at the end of the 15-day composting period. A separate "Curing Building" is now being built.

The total cost of improvements to date is $450,000. As of 1986, the compost was marketed at $4/ton to Earthlife (Doylestown, Penn.), a private firm which bags and sells it to gardeners (sometimes with nutrients added). It is monitored for heavy metals and toxins, but none have been found to prevent use of the compost in home gardens, on turf or as a soil amendment, according to the project operators.

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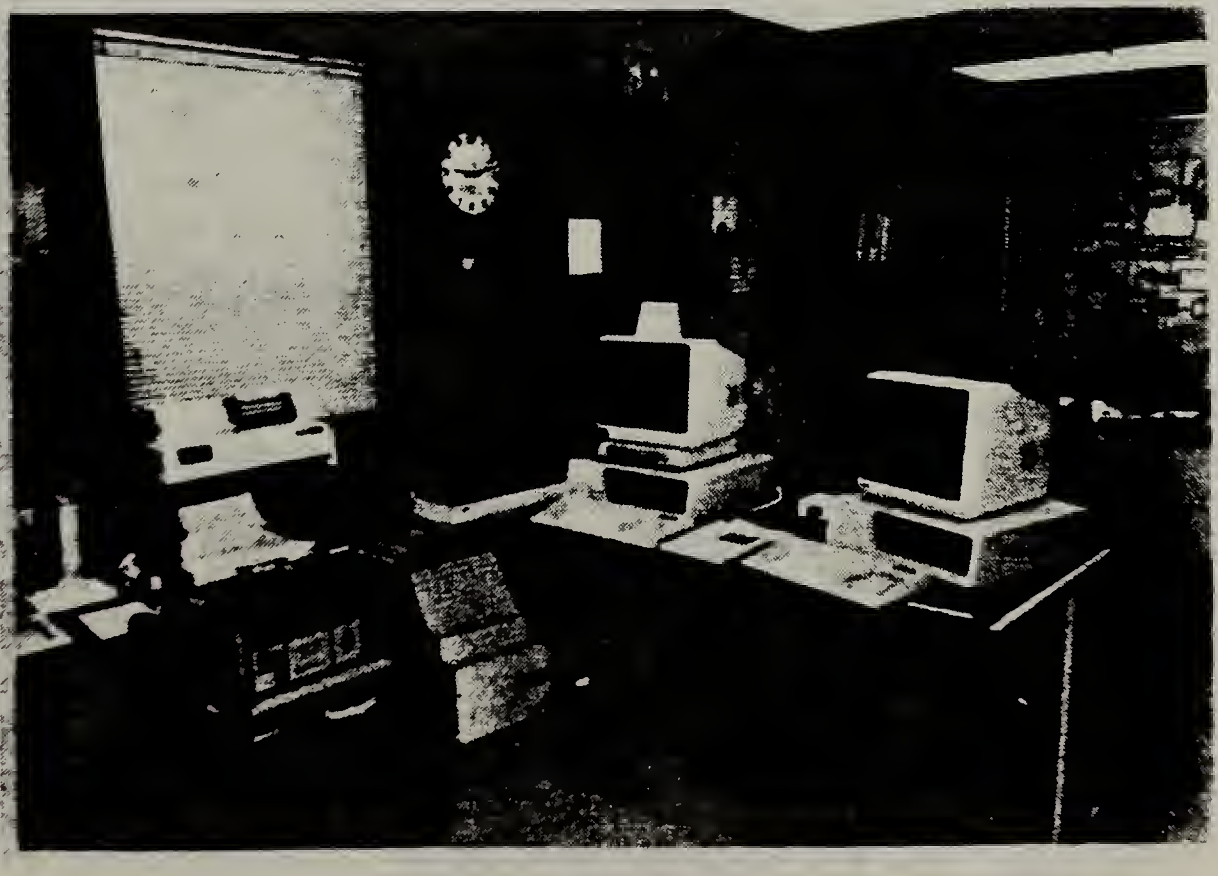
For more information: Biocycle, April 1987, p. 26; Solid Waste Management Newsletter, Cook College, Rutgers University, Vo. X, No. 5, 1986.

Sussex County, N.J. recently installed five enclosed compost buildings to help control odors and moisture. There are air trenches along the floor of each building. Curtains at front are closed when it rains. Exhaust fans can be seen in the rear. Below, a computer control system monitors pile temperatures at five-minute intervals, plots the data on a graph, and runs the system's numerous air blowers. (Courtesy Sussex County Municipal Utilities Authority)



Philadelphia, Penn. (Philadelphia Water Department)

Philadelphia decided to compost its sludge after considering land application and incineration. Composting was deemed to be the most cost-effective solution, was easier to site, and was relatively easy to start up. The system has grown from a pilot in 1975 to a full-scale, 65-acre operation handling sludge from three wastewater treatment plants serving a population of two million. The city now also takes in sludge from other communities.

The system used is the Beltsville aerated pile method. Dewatered sludge is trucked to the site and mixed with about twice the volume of woodchips. The mixture is then put in large windrows which are aerated by drawing air through them. After 21 days, the compost is put in curing piles and then shredded. Operations include four screening units, 1,000 feet of conveyors, truck loading facilities, a control tower, runoff collection, odor scrubbers and a woodchip recovery system.

The end product, called "Philorganic," debuted at Philadelphia's 1975 flower show and was given away free for publicity purposes. Today, the water department retains a marketing firm which will help market the product as a soil conditioner to landscapers, nurserymen and contractors. About half will be used in local municipal projects and in strip mine reclamation. Composting costs have been reduced to $25/ton.

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Montgomery County, Maryland (Washington Suburban Sanitary Commission)

The Montgomery County Compost Facility has been in daily operation since July 1983. It is a Beltsville aerated static pile system designed for flexibility and maximal operational control, and can handle 400 tons per day of dewatered sludge. The operation was phased in gradually to allow for experimentation and to ensure public acceptance.

Located in a high-density residential area, the facility is noted for its successful odor control system. Odors are avoided both by ensuring that operations are fully aerobic, through proper aeration, temperature control and moisture control, and through an air scrubbing system.

Moisture control is achieved by varying the chips:sludge ratio and providing more composting space to wetter blends. To facilitate drying, the compost pile is broken down after 21 days and restacked into a new aerated pile for at least four more days before screening and curing. To ensure uniform aeration, the piping is laid so that the further it is from the blower, the more perforations it has. The timer was adjusted so that the blowers come on more frequently as pile temperatures begin to rise. At the end of the composting period, the blowers are on continuously at maximum rates to promote drying and reduce odors.

All operations are under roof, and the aerated piles are fully enclosed. Originally, exhaust air was fed into a pile of cured compost which acted as an odor scrubber. This was replaced, after considerable study, with a full-scale exhaust air odor scrubbing system, which uses chemical compounds to react with and eliminate odors. The exhaust air is then diluted and discharged via a 110-foot stack.

The finished compost is bagged and marketed as "COMPRO" to landscapers, nurseries and building contractors for lawn maintenance and ornamental planting, and to institutions such as schools, hospitals and recreation departments for grounds work. Some is sold to retail outlets. The label lists the nitrogen, phosphorus and potash content of the compost, assures that its heavy metals content is minimal and safe, and gives instructions for appropriate use.

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For more information: Biocycle, July 1986, p.22; "Sludge Composting: Learning from Experience," Operations Forum, (U.S. Environmental Protection Agency), April 1985, p. 10.

Montgomery County, Maryland's aerated sludge compost piles are kept under roof. The fabric side walls were installed as an interim measure. (Courtesy Washington Suburban Sanitary Commission)

The Montgomery County facility installed a full-scale odor scrubbing system and a 110-foot stack for dispersing exhaust air. A compost curing pile can be seen at right. (Courtesy Washington Suburban Sanitary Commission)

Akron, Ohio (Akron Water Pollution Control Division)

The City of Akron began operating an enclosed mechanical composting facility in 1986, following an EPA-funded demonstration project. Akron chose an in-vessel system because of the area's wet climate, the need to avoid odors, and a desire to shield the facility from public view (the plant is adjacent to a national recreation area). The operation requires between 16 and 23 employees, depending on the volume.

All sludge processing and composting operations, except storage and curing, are housed within a single large building with extensive materials-handling equipment. The sludge, mixed with controlled proportions of sawdust, bark and recycled compost, is loaded into one of four rectangular bins. The long, narrow bins are lined with bark and gravel and aerated by a set of blowers. The direction of the airflow is reversible.

After five to seven days, the contents are extracted, remixed, and loaded into another bin for further composting. This process is repeated once per week for two to three weeks, until the compost is stabilized. The compost is then sent to long-term curing and storage, the length of time depending on the end use. In strip mine reclamation, the compost may be used almost immediately, while some horticultural uses may require six to 12 months of curing, plus shredding. Other suggested markets include landscapers and golf courses.

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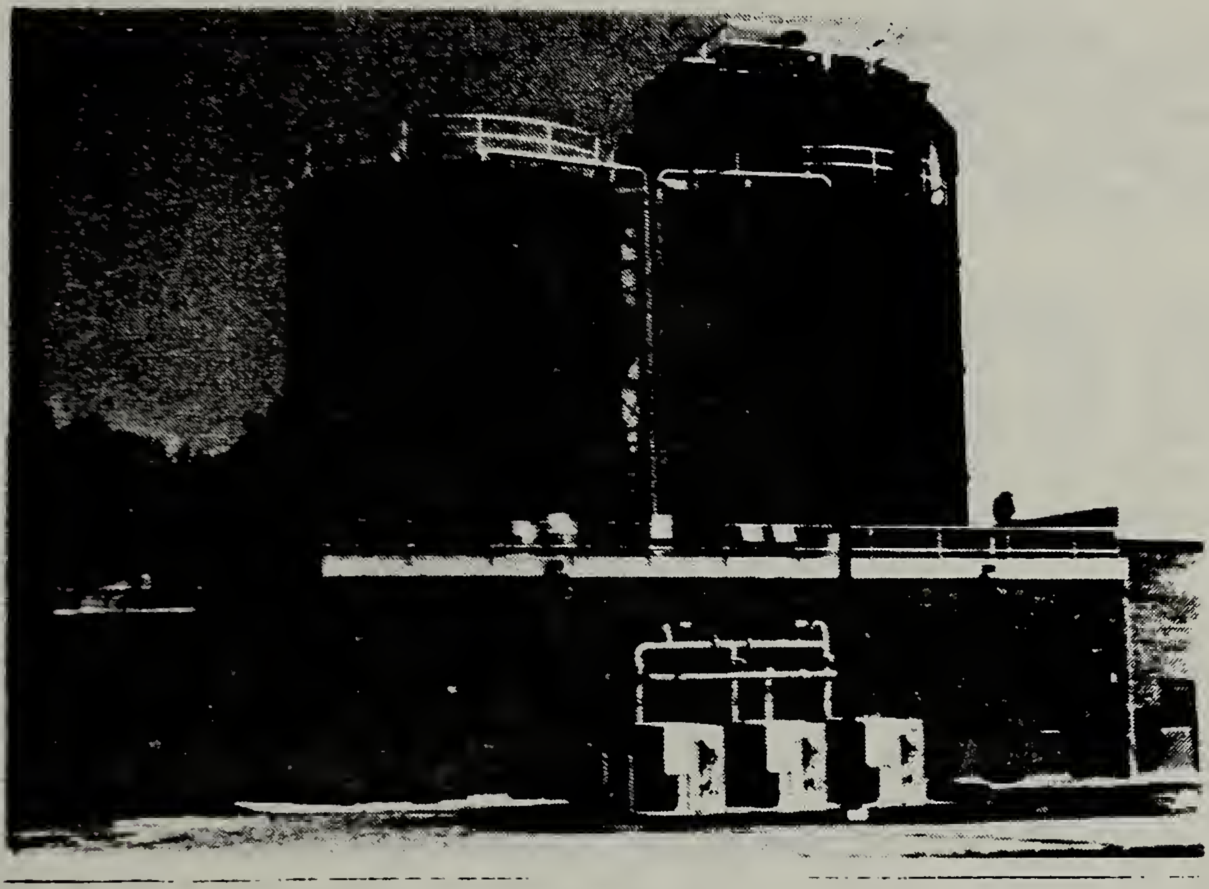
For more information: Biocycle, October 1984.

Portland, Oregon (Taulman/Weiss)

Portland has operated one of the country's first in-vessel sludge composting systems since October 1984. The $11.4 million Taulman/Weiss "turnkey" system, financed by 20-year revenue bonds, consists of four vertical, fully enclosed tanks called Bio-reactors, two curing reactors, and containers to hold the sludge and bulking agent (sawdust).

The system was chosen because it could fit into the limited space available (one acre), and because of the odor control afforded by a totally closed vessel. The vendor, Taulman/Weiss of West Germany, has a 20-year contract to market the compost and pays the city $10 per ton sold.

The Taulman/Weiss sludge composting and curing vessels may be located on the roof of a building housing sludge dewatering equipment, controls, blowers and conveyors. The pictured facility is in Clayton County, Georgia. (Courtesy Taulman/Weiss)



Dewatered sludge, mixed with recycled compost and sawdust, is placed into the top of the Bio-reactor. Air is fed into the bottom of the tank; gases are drawn off the top. Inside, temperature zones are created, each with different microorganisms. As the sludge travels down through the tank, it proceeds through the various stages of composting. The compost is not turned or agitated, unlike some other systems.

A computer monitors temperature and oxygen levels to control the volume of airflow. After approximately 14 days, the partially composted sludge is transferred into the cure reactor to stabilize. Air is fed in continuously to promote curing and remove moisture. After 20 days, the finished compost is removed and sold to golf courses, landscapers and nurseries.

The Taulman/Weiss system has relatively low power requirements and operating costs, and little machinery other than air blowers, conveyor belts and feeding devices. Other Taulman/Weiss systems are operating in East Richland County, S.C., Clayton County, Ga. and Endicott, N.Y.

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For more information: Biocycle April 1986; July/August 1983; November/ December 1983.

SOLID WASTE COMPOSTING (CO-COMPOSTING)

Co-composting is the simultaneous decomposition of two or more types of waste, usually mixed municipal solid waste (MSW) with sludge or other materials rich in nitrogen. The two types of waste are complementary -- the sludge provides moisture and nitrogen, and the MSW acts as a bulking agent, adding porosity and absorbing moisture.

Although co-composting has been done in Europe, Asia and the Middle East for many years, there are currently only a handful of operating facilities in this country. However, many European vendors are establishing American marketing offices, and are often willing to provide a warranty bond and set up pilot projects with which communities can experiment. Several European technologies are described below.

Co-composting can be an economical way to handle solid waste and need not require a large capital investment. Some smaller systems co-compost in simple windrows or aerated piles enclosed in a shelter. For large cities or groups of communities, there are a number of scaled-up, mechanized systems to choose from. Some of the larger ones make other products including baled ferrous metals and refuse-derived fuel (RDF) which can be burned for energy.

Co-composting involves three basic steps -- initial handling and preparation of the waste, actual composting, and post-processing.

Much of the cost in co-composting is in preparation. Although not all systems call for it, glass, metals, plastics and other inorganic materials should be removed to reduce wear and tear on equipment and improve the quality of the product. If your community plans to co-compost, recycling and hazardous waste collection programs are strongly recommended. Both will help reduce contaminants and increase options for using the compost.

Before composting, the garbage is generally shredded to reduce particle size. If sludge is not used, water may be added to achieve the desired 50-60 percent moisture content. When the process is complete, the compost should be allowed to cure and stabilize. Some facilities, designed to produce a high-quality product, offer sophisticated post-processing equipment. Such equipment is not always needed and adds greatly to the processing costs.

Potential end-uses for co-compost include horticulture, landscaping, landfill cover and maintenance of public lands. The product should be thoroughly tested for nutrient content and contaminants.

Delaware Reclamation Project (Fairfield Digester System)

Since 1983, the Delaware Reclamation Project has served a population of about 450,000 in New Castle County, an urban industrial area. Owned by the Delaware Solid Waste Authority, it combines separation of recyclable materials, production and burning of refuse-derived fuel, and the first large-scale solid waste composting system in the country. In order to secure financing for the $73 million project, the Authority stipulates that haulers take the county's trash to the facility. As of spring 1987, the fee to communities was $32.84/ton.

Original plans called for a resource recovery plant only, but the City of Wilmington needed a sludge disposal solution. The facility takes in about 1,000 tons per day of municipal solid waste, and composts some 330 tons with an equal portion of sewage sludge. About 17-20 percent of all material entering the plant is composted, and ten to 15 percent is landfilled.

At the front end of the facility, the trash is shredded and air-sorted into light, heavy and ferrous components. The light fraction (mostly light paper and plastics) is used to make RDF; the heavy portion goes through a series of additional separations for metals, sand and glass. The remaining, largely organic material is mixed with sludge and fed into the commercial Fairfield Digester System for composting.

The four Digesters are circular vessels with large rotating screws which aerate the material and move it toward a discharge point in the center. Air is forced in with a blower and pipes. Sensors and controls regulate the speed of the screws and the amount of air in the system to maintain the desired temperatures. After five to seven days, the compost is dried and screened, but not cured.

The system produces nearly 200 tons per day of compost, about 70 percent of which is now used as landfill cover. A small percentage is further stabilized in static piles and sold to the horticultural market. The rest is simply landfilled. Under its contract, Fairfield is responsible for all compost sales, and is still in the process of developing markets. Original plans called for marketing it as a poultry litter, but this end-use was set aside when tests found small quantities of PCB's.

Fairfield also has operating experience with solid waste composting in Altoona, Pa.; Key West, Fla.; Toronto, Canada and Clinton County, N.Y.

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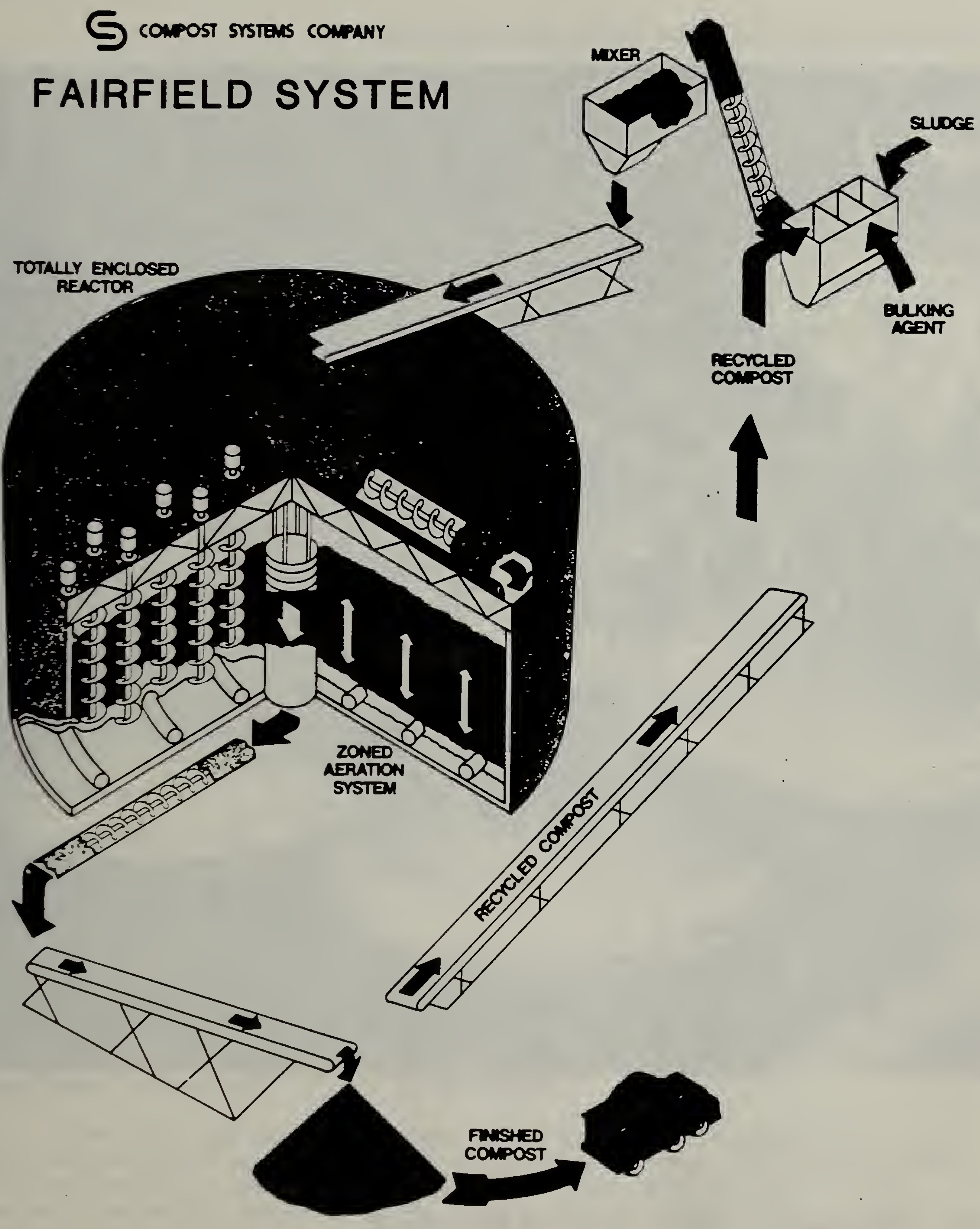
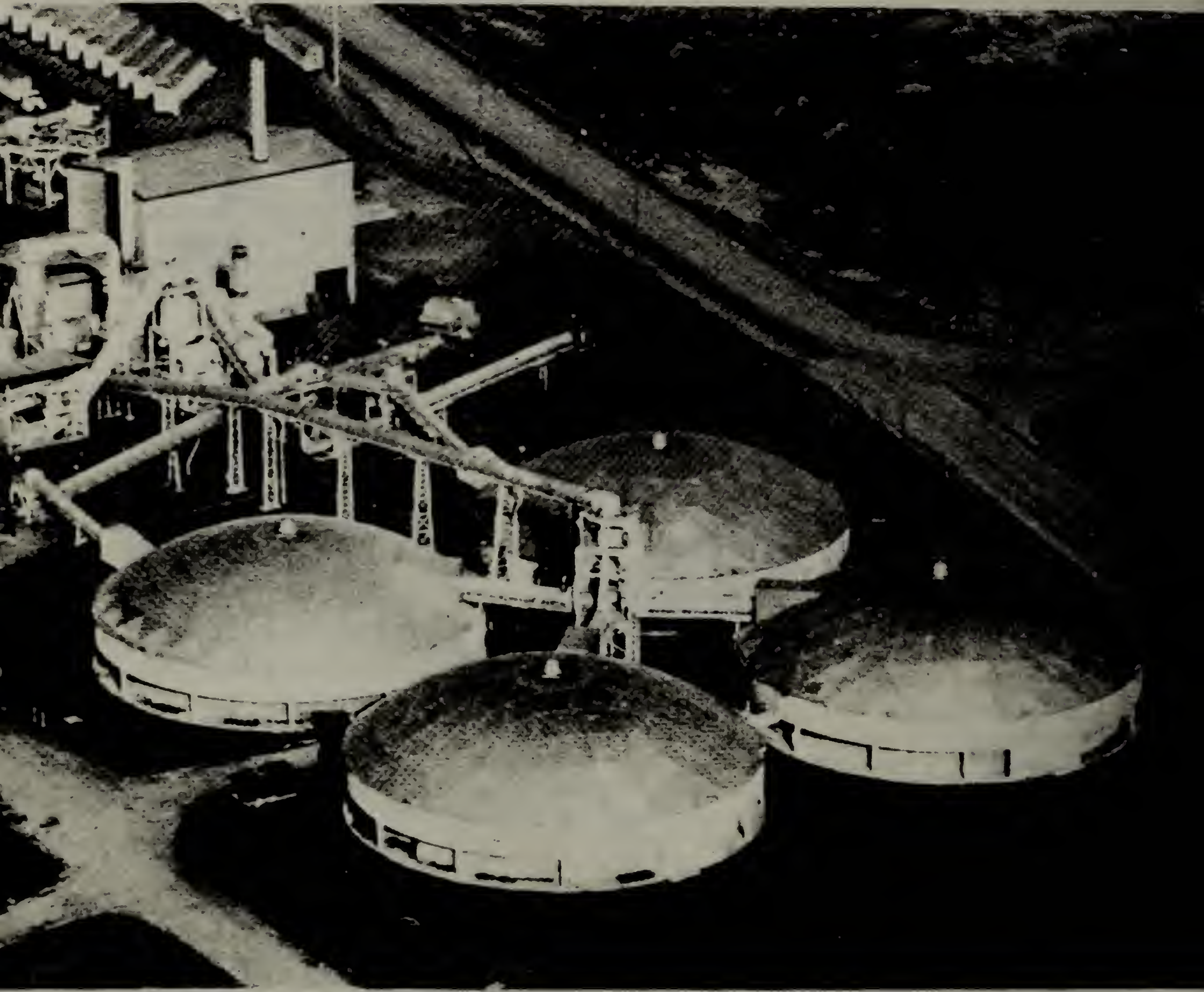


COMPOST SYSTEMS COMPANY

FAIRFIELD SYSTEM

Each enclosed Fairfield Digester receives a mixture of pre-separated, mostly organic waste combined with sewage sludge. The rotating augers mix and aerate the materials. The compost is discharged after five to seven days, then dried and screened. Some is further stabilized in static piles and sold.

An aerial view of four Fairfield Digesters.



Lodi, Wisconsin (University of Wisconsin)

This state-funded pilot project is designed to demonstrate a low cost, low technology process suited for small communities (population 2,500 or less). All equipment used is off-the-shelf, to show that existing machinery may be adapted for composting. The project requires one full-time operator with a part-time helper.

The facility accepts eight to ten tons of solid waste per week, or two truckloads, from several nearby communities. Some of the waste arrives source-separated, with glass, metal, newsprint and cardboard removed. The waste is fed into a shredder, and many non-compostable items (clothing, hard plastics, leather, rubber, metal, glass) are removed by hand and landfilled. The remaining material is shredded twice, then put in a mixer and combined with wet sewage sludge and some finished compost. After 20 minutes of mixing, the wastes are formed into indoor static piles aerated by blowers. The piles are covered with a thin layer of finished compost to eliminate odors and flies.

After six to eight weeks, the piles are screened with a grain screen used in farm operations. The coarse screenings are landfilled, and the remaining compost is mixed with water and set in a curing pile, where it is further broken down. The end product is stored and tested for nutrients, heavy metals and other contaminants.

According to Aga Razvi Ph.D., the project consultant, this system is suitable for processing 10 tons per day of solid waste, operating five days per week for under $200,000 in equipment costs. He estimates that it can compost 68 percent of all incoming trash (higher if there is an accompanying recycling program), at disposal fees of less than $40/ton, excluding any possible revenues from compost sales.

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For more information: Biocycle, August 1986, p. 26.

Portage, Wisconsin (City of Portage)

The City of Portage, population approximately 12,000, began co-composting its solid waste and sewage sludge in December 1986 to extend the life of its landfill. This medium-sized, city-owned operation handles 30 tons per day of solid waste, diverting about 70-80 percent from the landfill. All equipment used was adapted from other uses. The operation is expected to extend landfill life from five to 15 years.

Plastic bags of partially sorted garbage are loaded intact, with no pre-processing, into a long, narrow steel drum, located inside a building on the landfill site. Liquid sludge is added to the drum, which rotates 24 hours a day at a very slow speed. The sludge and solid waste are mixed and shredded as they tumble in the drum. The waste heats up rapidly, and is aerated by a fan. The drum is kept about half full, and waste is added three times per week.

After seven days, the partially composted waste comes out the other end and is moved into a rotating screen which removes large items such as clothing, shoes, plastic bags, metal cans, rigid plastic objects, etc. These items are sent to the landfill. The remaining material, consisting of organic materials as well as some plastic and glass, is taken to an outdoor composting pad and formed into piles for further composting. The piles are turned periodically with a front-end loader. After the compost is fully cured, it is screened again to remove the coarse and inorganic material.

The capital cost of the facility was $850,000. It employs one full-time operator and charges a tipping fee of $28/ton. All compost produced is being stored on site, and will be marketed to landscapers, greenhouses and farmers. Heavy metal concentrations vary, and may limit the end uses of the product. Dr. Aga Razvi, consultant to the project, has conducted a detailed analysis of the product's chemical contents and the potential for groundwater contamination.

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Eden Prairie, Minn. (Buhler-Miag/Reuter, Inc.)

Buhler-Miag, founded in 1860, is a Swiss firm specializing in processing and materials handling for a variety of markets. It has built some 75 co-composting facilities in Europe, Asia, the Middle East and Mexico beginning in 1957, and has teamed with Reuter, Inc. (Hopkins, Minn.) to offer a full-service waste processing package. As of spring 1987, the company is scheduled to open a privately-owned RDF and recycling facility in Eden Prairie, Minn. in the near future. The heavy reject fraction of the waste will be transported to another site for composting.

Existing Buhler-Miag composting facilities process volumes ranging from 27.5 to 3,000 tons per day. In a typical plant, MSW is shredded in a hammermill after removing bulky items. It is then fed into a rotating drum with a trommel screen to separate the RDF and compostable fractions. The RDF material passes under a magnet to remove the ferrous metals, and the compostable material is placed in a drum and mixed with sludge or septage.

The compost mixture is formed into windrows on a composting pad, enclosed within a shed. The windrows are aerated and turned by a windrow machine, which also adds water as needed. When composting is completed, the coarse compost is fed through a lumpbreaker to another drum, where a trommel screen separates fine compost from oversize material. If desired, the compost can be further processed by a "de-stoner," originally developed for the grain industry, to remove pebbles and glass.

Buhler-Miag has an arrangement with Minneapolis and some adjacent counties requiring that they send their waste exclusively to the facility, and hopes to sign 20-year contracts. The vendor expects to process 85-90 percent of all incoming solid waste at projected disposal fees of $35-45/ton.

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A Buhler-Miag windrow turner aerates a mixture of sludge and processed solid waste in an enclosed composting area. The coarse compost is then fed through a lumpbreaker, trommel screen, and an optional de-stoner.

Crow Wing County, Minn. (DANO)

DANO is a Swiss vendor of composting systems which has over 200 plants in Europe, Asia and the Middle East. Like many of the European firms, DANO has opened marketing offices in the United States, and hopes to open its first American facility in Crow Wing County in 1988. The facility will process between 120 and 180 tons per day of MSW and will use the compost as landfill cover.

In the DANO process, raw refuse is fed onto a conveyor for magnetic separation or hand-picking of recyclable items. No preprocessing with hammermills or shredding is needed, but these may be installed if desired. The remaining material is loaded into a long rotating drum lined with v-shaped "spears", called the Biostabilizer. Dewatered sewage may be added if desired. The high temperatures, friction and the tumbling action of the drum cause the refuse to begin to disintegrate. The warm exhaust air is used to preheat incoming refuse.

After about 24 hours in the drum, the pulverized material is placed in aerated piles for four to six weeks for actual composting. The finished compost is removed to curing piles for an additional three weeks, and then screened for glass, metal and plastic.

The DANO system is relatively uncomplicated, with average capital and operating costs. It has a number of different possible configurations, depending on scale and the compost quality desired. One disadvantage is that 20-30 percent of incoming waste must be rejected to a landfill, more than many other systems claim. This is because some materials do not break up sufficiently to be composted, and because the system does not separate materials for RDF production.

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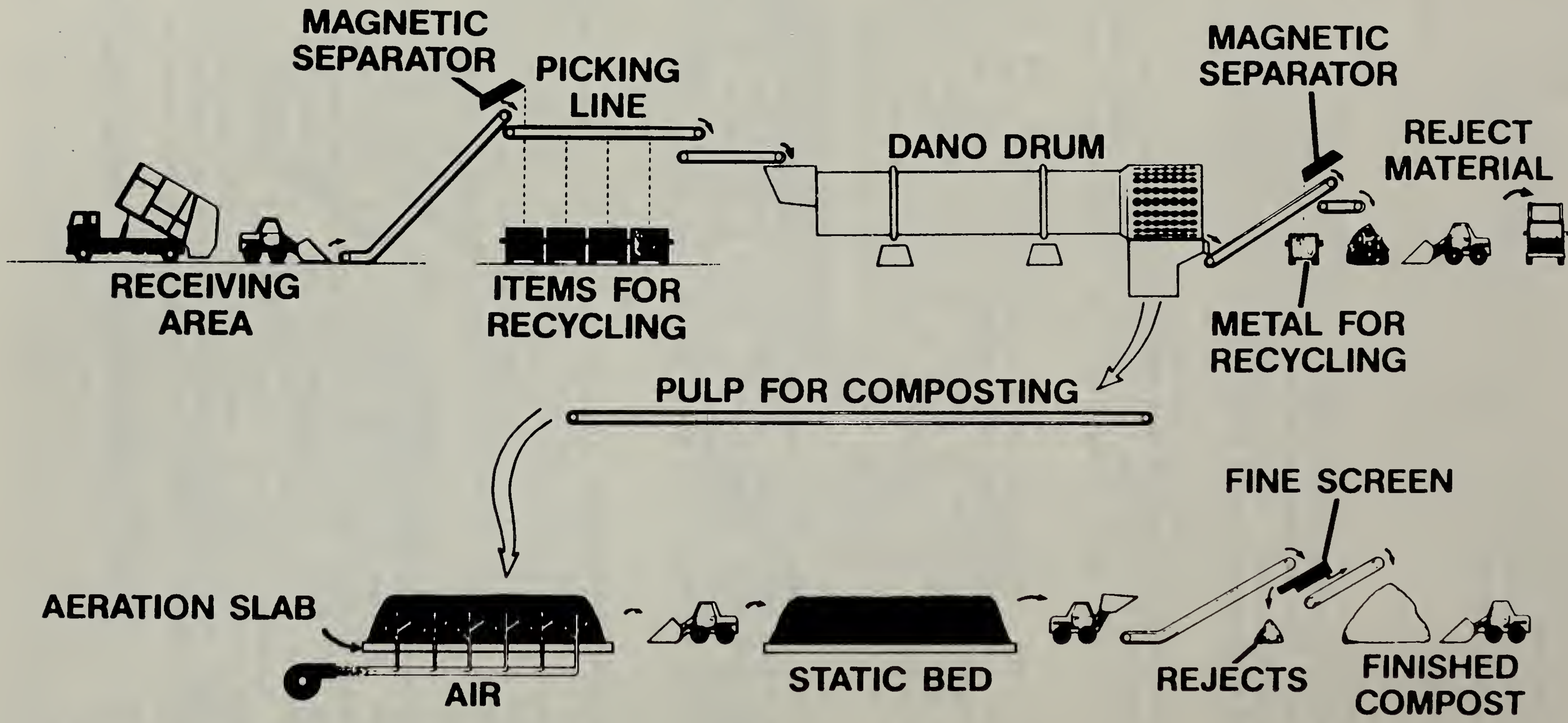
A two-drum DANO installation in Salford, England. The drums measure 12½ ft. wide and 80 ft. long. (Courtesy Waste Processing Corp.)

THE DANO SYSTEM



In the DANO process, refuse is broken up in a long rotating drum and formed into aerated piles for composting.

Big Sandy, Texas (Eweson Digester System)

Ambassador College in Big Sandy has been operating the Eweson Digester System intermittently since 1972, and has composted various combinations of MSW, sewage sludge, brewery sludge, poultry manure, sawdust and wastepaper. Recently, a firm bought the rights to manufacture and sell the system for solid waste composting. It now takes in 20 tons per day of trash from the Ambassador College campus and the nearby town of Gladewater and composts it with liquid sewage sludge. It operates seven days a week with the process taking three to six days. The compost is sold to the horticulture market.

A unique feature of the Eweson Digester System is that it requires almost no pre-processing. Only large metal objects, tires, large pieces of fabric, ropes and other bulky items are removed. There is no pre-sorting, shredding or grinding. (Eweson does offer the option of separating magnetic metals and cardboard for recycling.)

Bagged municipal solid waste is dumped into the first compartment of a long, slowly rotating drum. Sewage sludge is added by means of a pump. The wastes then move through a series of three compartments, spending one to two days in each. About 15 percent remains behind in the first compartment to act as a starter for the next batch.

Teeth on the inside of the drum, along with the tumbling action, break up, agitate and aerate the materials. As the drum rotates, air circulates through it at controlled rates. The speed of rotation may be varied to adjust temperatures -- the slower the speed, the higher the temperatures. Air vents and insulation also help regulate temperature. Each compartment has its own set of controls.

When the compost is discharged from the drum, it is screened to remove the inorganic portion, which is landfilled. The compost is then placed in static piles for two to three days to stabilize. No drying equipment is needed.

Laboratory tests have found high plant nutrient levels and acceptable pH and heavy metal levels. According to the vendor, the Eweson Digester System requires about one acre of land per 150 tons per day of wastes processed. Although the digesters can be built larger, a modular system with multiple digesters is recommended.

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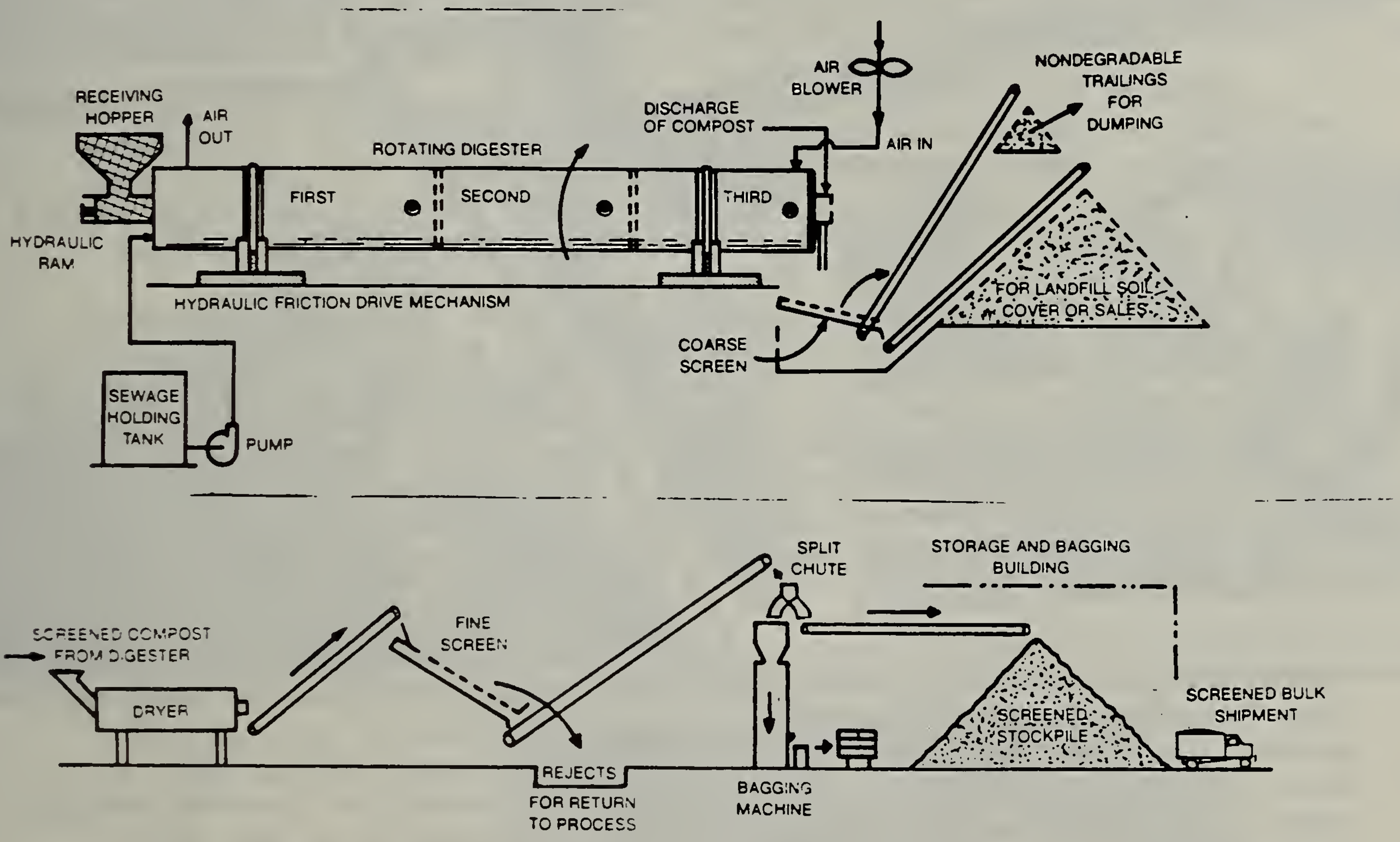
Solid waste, with only bulky objects removed, is loaded into the first of the Eweson Digester's three compartments and combined with sewage sludge. Projections on the Digester's walls break up the materials as it rotates. The materials are retained in each compartment for one to two days, then discharged, dried, screened and allowed to cure in piles for two to three days. (Courtesy Bedminster Bioconversion)



Ford County, Kansas (Geophile International Inc.)

Ford County, a rural area with a population of about 25,000, began composting its solid waste in a small windrow system in fall, 1986. The system handles about 100 tons per day of solid waste, and is operated by the Public Works Department of Dodge City, the county's largest municipality. Communities pay a tipping fee of $7/ton.

In this operation, MSW is composted without the addition of sludge. Bulky items and metals, about 30 percent of the incoming waste, are hand-picked out, but there is no further separation. The county has use of a special mill, developed by a private inventor, which grinds the remaining trash to a fine "fluff material" about a quarter the original volume.

The ground garbage is put in windrows outdoors on a concrete pad. Geophile International Inc. (GII), a private entrepreneur, provides a patented enzyme which is added as a starter, as well as a Scarab composting machine for turning the windrows. Thermometers and moisture probes monitor the piles and are checked twice daily. Moisture is added as needed.

Composting is complete after about six weeks. The operation requires two part-time employees. The end-product, which GII will market under contract, contains tiny bits of plastic and glass, resembling vermiculite. It is now being chemically tested and is being given to wheat farmers to apply on their fields.

GII has done testing on the Dodge City site for the past three to four years, and is now marketing a scaled-up, packaged version of Ford County's operation. The company has had numerous tests performed and says its compost is high in nutrients with acceptable contaminant levels. GII aims to produce a bagged product and hopes to establish its safety for agricultural as well as construction and landscaping markets. It promises to return to communities 30 percent of gross revenues from sale of the compost.

GII's first facility, serving a potential population of 100,000-150,000 in Sumter County, Fla., is scheduled to open in late summer, 1987. GII claims it will be able to process 90 percent of incoming trash. The system includes mechanized materials handling equipment, overhead magnets for ferrous metals separation and hand-sorting of recyclable materials for sale. The windrow operation will remain outdoors, on a graded clay, asphalt or concrete surface with a lagoon system to contain runoff on the site.

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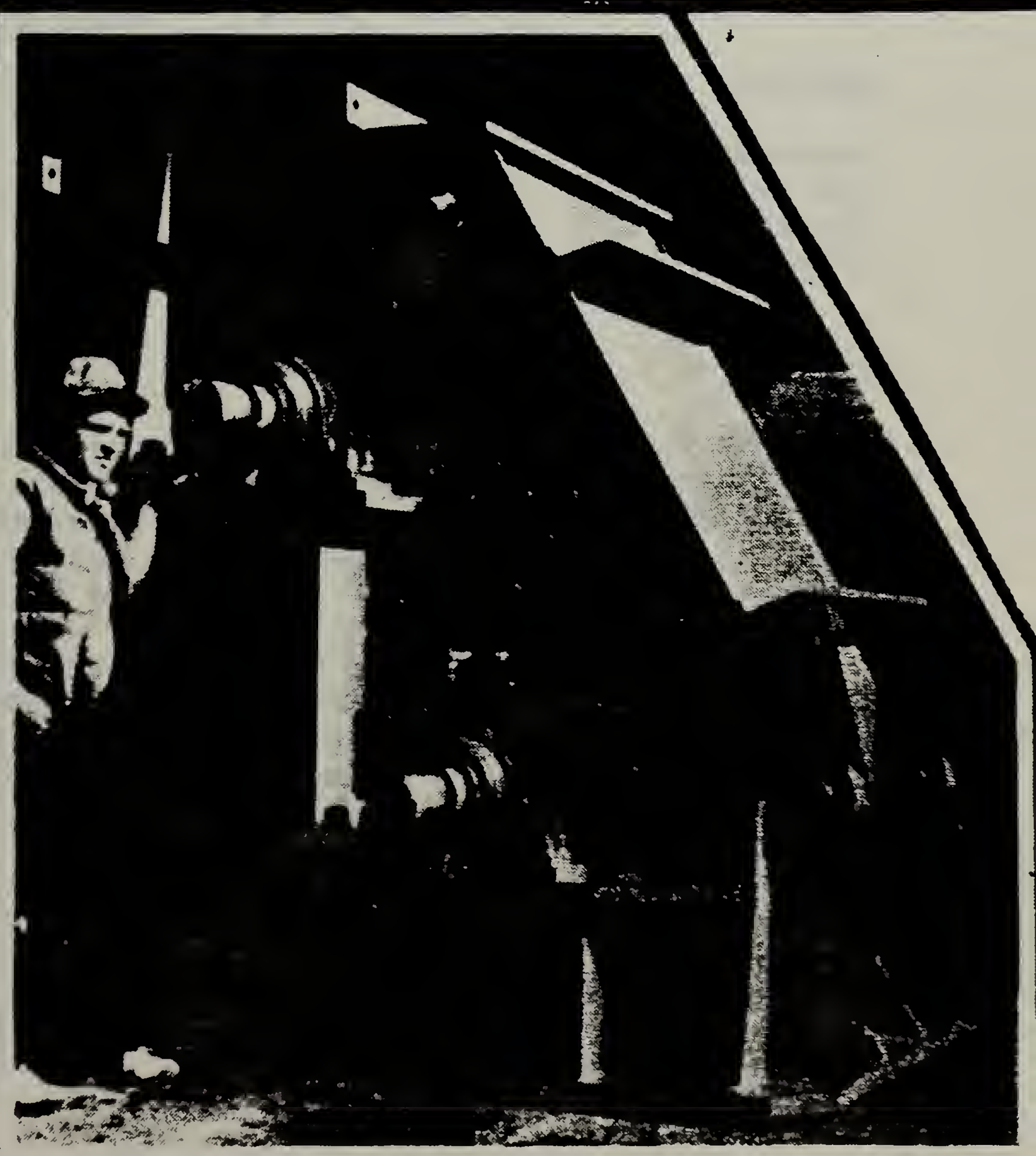
Double Rotor Flailmill Horizontal

In Geophile International's system, mixed MSW is ground in a heavy-duty flailmill and put in windrows, turned by a Scarab windrowing machine.



Double Rotor Flailmill Vertical

PLM-Selbergs

PLM-Selbergs is a Swedish firm with marketing offices in Greenwich, Conn. Its "Brini" process transforms MSW into refuse-derived fuel, baled scrap iron and compost. It can also sort paper if a market is available. In Europe, PLM provides its own collection containers, sorting stations and collection vehicles, and claims to process 90 percent of incoming waste. PLM has operating facilities in Europe and the Middle East and at press time was negotiating a contract for an RDF facility in Minnesota.

A typical PLM facility shreds incoming MSW in a hammermill, and uses a ballistic separator to sort it into three fractions -- a light fraction, with paper and light plastic, used for RDF; an organic, compostable fraction; and a heavy fraction consisting of heavy plastics and metals. The RDF fraction is dried, pelletized and shipped to market.

The compost fraction, which still contains sand and glass, is mixed with sludge and septage and placed on an outdoor pad. A large windrow-turning machine aerates the material. Because the system is designed primarily for RDF, its compost is of marginal quality. In Europe, quality is not so much of a concern since they use the material primarily as landfill cover. However, the system is reliable and non-labor intensive.

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OTV

OTV is a French firm with experience at 24 operating facilities in France and the Middle East. The firm is now trying to introduce its Siloda system of co-composting to the American market. In France, the compost is used in agriculture, mainly in vineyards, so this system is designed to make a quality product.

Like the Buhler-Miag system, the Siloda system produces RDF as well as compost, and has similar pre-processing methods. The compostable fraction of the incoming MSW goes through a vibrating screen and a glass separator, then placed in horizontal silos or open-ended bins about eight feet high.

The bins have aeration troughs running down the center. A paddle-wheel device turns and further aerates the compost, and drops it onto a conveyor which transfers it to the next bin for further composting. After eight to 14 days in the bins, the compost is allowed to cure for up to two months, and is then shredded and screened.

The system is considered reliable and produces a good-quality compost.

Contact:

Paul Mousty
OTV
11, Avenue Dubonnet
92407 Courbevoie Cedex
France
(1) 774 46 64

GLOSSARY of COMPOSTING TERMS

AERATED PILE COMPOSTING. See STATIC PILE COMPOSTING.

AEROBIC COMPOSTING. Decomposition of organic wastes by bacteria in the presence of oxygen. See COMPOSTING.

AGRICULTURAL WASTE. Waste materials produced from the raising of plants and animals, including animal manures, bedding, plant stalks, hulls, leaves, and vegetable matter.

AIR CLASSIFICATION. The separation of mixed waste materials using a moving stream of air. Materials are separated based on weight, size, shape and aerodynamic characteristics. Light waste components (paper, plastic film, textiles, dust, etc.) are carried upward in the air stream, while heavy components (glass, metal, wood, bulk plastic, etc.) drop out of the stream. Air classification is usually done after the waste has been shredded.

ANAEROBIC DIGESTION. Decomposition of wastes in the absence of oxygen.

AQUIFER. An underground bed or stratum of earth, gravel or porous stone that contains water and frequently serves as a source for a well.

AUGER. A device for boring, shaped like a screw.

BALER. A machine used to compress and bind solid waste and/or other materials to reduce their volume.

BALLISTIC SEPARATION. The separation of shredded solid waste into two or three distinct components. Ballistic separators often consist of an inclined conveyor which operates on the principle of gravity -- heavy materials fall back, and lighter materials are carried up on the conveyor. Additional materials may fall through perforations in the separator.

BELTSVILLE SYSTEM. A process for static pile sludge composting developed by the U.S. Department of Agriculture in 1975. Most existing facilities in the U.S. are of the Beltsville type. In recent years, the process has been modified to develop a new system known as the Rutgers Strategy. (See RUTGERS STRATEGY)

BTU (BRITISH THERMAL UNIT). The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit. Refers to a material's energy value.

BUFFER ZONE. Area between the composting operation and homes or other sensitive land.

BULKING AGENT. Carbonaceous material, such as sawdust or woodchips, added to a compost system to maintain airflow by preventing settlement and compaction of the waste.

BULKY WASTES. Large items of refuse such as appliances, furniture, carpets, trees, stumps and large auto parts.

CARBONACEOUS. Material with carbon-to-carbon bonds; organic material. Composting always requires a carbonaceous material.

CLASSIFICATION. To arrange or sort waste materials into uniform categories or classes, usually by size, weight, color, etc.

CO-COMPOSTING. The composting of solid waste with high-nitrogen materials such as sewage sludge, septage or manure. The term sometimes refers generically to the composting of any mixed waste materials.

COMMERCIAL WASTE. Waste material which originates in wholesale, retail or service establishments such as office buildings, stores, markets, hotels, theaters, hospitals and other institutions. Usually collected by private haulers.

COMPACTION. Compressing of solid waste to reduce its volume. Compaction allows for more efficient transport.

COMPACTOR ("PACKER") TRUCK. A large truck with an enclosed body with special power-driven equipment for loading and compressing waste materials.

COMPOST. Thoroughly decomposed, humus-like organic matter produced through composting and suitable for application to the soil. Depending on the waste source, compost may also have some agricultural value.

COMPOSTING PAD. An area with a clay, asphalt or concrete surface on which waste materials are left to compost.

COMPOSTER. See WINDROW MACHINE.

COMPOST FACILITY. A site used to compost or co-compost solid waste. A facility may include materials processing and handling equipment; structures to control drainage, collect and treat leachate; and storage areas for the incoming waste, the final products, and any residual materials.

COMPOSTING. The controlled decomposition of organic waste by naturally occurring bacteria, yielding a stable, humus-like product. The composting process also produces heat, water and carbon dioxide and reduces the volume of the wastes by 40-75 percent.

CONTAMINANT. Foreign material that makes a primary material impure. Sometimes refers to a toxic material.

CONVEYOR. A mechanical device used to move materials between operations or as part of a processing system.

COVER MATERIAL. Soil or other suitable material used to cover wastes, daily or periodically, in a properly operated sanitary landfill.

CUBIC YARD. A standard measure of waste volume. For leaves, one cubic yard is roughly equivalent to 500 lbs. or 1/4 ton, assuming an average rate of compaction. For municipal solid waste, the formula varies depending on the kind of waste, its density and moisture content.

CURING. The final stage of composting, after much of the readily metabolized material has been decomposed, in which the compost material stabilizes and dries. Compost is considered cured if it does not reheat when wetted to 50% moisture.

CYCLONE SEPARATOR. A mechanical separator which uses a swirling air flow to sort materials according to weight.

DECOMPOSITION. The breaking down, or destruction, of dead organic materials.

DENSIFICATION. Making materials fit into a smaller volume through baling, shredding, crushing and other methods. Makes transport more economical.

DE-STONER. A machine which removes pebbles and glass. Originally developed by the grain industry, it is now used in some waste separation systems.

DEWATERED SEWAGE SLUDGE. Any sewage sludge with a total solids content of 20 percent or greater or which can be transported and handled as a solid material.

DIGESTER. An enclosed compost system with a device to mix and aerate the waste materials. Digesters may be circular vessels using rotating augers or screws to mix and turn the material. Others are long, rectangular bins with equipment which travels along the length of the bin, similar to a windrowing machine.

DISPOSAL. Making final deposition of waste materials at a sanitary landfill, composting facility, resource recovery plant or other site.

DOMESTIC WASTE OR SLUDGE. Solid waste or sludge which originates in residential private households or apartment houses.

DRUM COMPOST SYSTEMS. Enclosed cylindrical vessels which slowly rotate for a set period of time to break up and decompose solid wastes. In some systems, the drum is used solely for mixing materials, which are then formed into windrows or static piles.

In other systems, the wastes are retained in the drum for a longer period of time and emerge partially or fully composted. The drum walls may contain projections to facilitate break-up of the materials. Some drums contain two or more chambers.

EMISSION. The gases, vapor and particulates that are released to the atmosphere from a solid waste or other facility.

FERMENTATION. Anaerobic decomposition of organic compounds.

FERROUS. Metals which are predominantly composed of iron.

FLOW CONTROL. A practice by which state, county or local officials seek to guarantee the flow of all waste to a particular disposal facility. This may involve a contract provision, a local ordinance or legislation.

FOOD CHAIN CROPS. Crops grown for human consumption; also tobacco and feed for animals whose products are consumed by humans.

FRONT-END LOADER. A refuse truck with power-driven loading equipment at the front of the vehicle. Sometimes referred to as a bucket loader.

FRONT-END RECOVERY. The salvage of usable waste materials at a waste processing facility prior to burning, shredding or other processing.

GRAVITY SEPARATION. Concentration or separation of materials by gravity, based on differences in their specific gravity and size.

GROUNDWATER. Water present in an aquifer, or which saturates the pore spaces of the rock or soil under the surface of the ground. It is often the source of drinking water. Groundwater can travel from one area to another and is often a source of surface (i.e. spring or stream) water. It can become polluted from improper waste disposal practices.

HAMMERMILL. A type of crusher used to break up waste materials into smaller pieces or particles, using rotating or flailing heavy hammers.

HEAVY METALS. Metallic elements with higher molecular weights, generally toxic in low concentrations to plant and animal life. Such metals are often residual in the environment and accumulate through the food chain. Examples include mercury, chromium, cadmium, arsenic and lead.

HOUSEHOLD HAZARDOUS WASTES. Materials used in the home which are toxic to humans, animals and/or plants, such as paints, solvents, motor oil, batteries, cosmetics, chemical cleaning agents, etc.

INDUSTRIAL WASTE. Waste materials discarded from industrial operations or derived from manufacturing processes.

INORGANIC. Substance in which there are no carbon-to-carbon bonds; mineral matter.

INOCULANT. A substance added to a compost pile as a "starter" to stimulate bacterial activity. It sometimes consists of an enzyme or a bit of partially composted waste.

IN-VESSEL COMPOSTING. Uses mechanized equipment to compost wastes in an enclosed area with controlled amounts of moisture and oxygen for rapid decomposition. Often, a large rotating drum or an auger mixes the wastes as they decay. See DIGESTER.

LAND APPLICATION. Sewage sludge spread on the surface of the land.

LEACHATE. Liquid which has percolated through a composting pile or landfilled solid waste. Contains dissolved, suspended and/or microbial contaminants.

LOADER. A type of enclosed compactor truck equipped with a loading hopper at the rear and a large mechanized panel which sweeps the solid wastes or compost into the body of the unit.

MAGNETIC SEPARATOR. Equipment used to extract magnetic (ferrous) materials from the waste stream. Usually consists of an overhead belt, drum or pulley with a permanent or electro-magnet.

MANUAL SEPARATION. The separation of waste materials by hand. Sometimes called hand picking. Manual separation may be done in the home or office (source separation), or at a waste facility.

MATERIALS RECOVERY. The collection, separation and processing of waste materials for reuse and/or sale.

MECHANICAL SEPARATOR. Any separator of waste materials which is of mechanical design, such as cyclone and screen separators.

MICROBE. A living organism which can be seen only with a microscope.

MSW. Abbreviated term for municipal solid waste.

MUNICIPAL SOLID WASTE. Garbage, refuse, trash and other solid waste from residential, commercial and community activities. Generally refers only to waste collected by the municipality. Generally does not include auto hulks, ash, construction debris, mining waste, sludges, tires or other materials collected and disposed of as separate waste streams.

N:P:K RATIO. Refers to the ratio of nitrogen:phosphorus:potash in a compost product, indicating its fertilizer value. Composting "recipes" can be developed to yield a more favorable N:P:K ratio.

NEGATIVE PRESSURE AERATION. Aeration of static compost piles by drawing air in through the piles. The reverse of positive pressure aeration.

NONFERROUS METALS. Metals other than iron and steel that are found in solid waste, such as aluminum, copper, zinc, lead and alloys such as brass and bronze.

OPEN-PILE COMPOSTING. See WINDROW COMPOSTING.

ORGANIC WASTE. Waste composed of materials which contain carbon-to-carbon bonds and are biodegradable. Includes paper, wood, food wastes and yard wastes.

PATHOGENS. Organisms that are capable of producing infection or diseases, often found in waste materials. Pathogens are killed by the high temperatures of the composting process.

PAYLOADER. A bulldozer.

PERCOLATION. Downward flow or infiltration of water through the pores or spaces of rock or soil.

pH. A measure of how acidic (pH less than 7) or basic (pH above 7) a material is.

POSITIVE PRESSURE AERATION. Aeration of static compost piles by blowing air up through the piles. Sometimes called forced aeration. Reverse of negative pressure aeration.

PUGMILL. A piece of heavy equipment used for mixing and size reduction.

PUTRESCIBLE. Organic materials prone to degrade rapidly, giving rise to obnoxious odors.

RDF. Abbreviated term for refuse-derived fuel.

RECOVERY RATE. The percentage of material that is recycled or composted, thus avoiding landfilling or disposal at an incinerator or resource recovery facility.

REFUSE-DERIVED FUEL (RDF). A solid fuel produced from solid waste, by shredding, pulverization or other mechanical processing and the removal of recyclable and non-combustible materials. RDF may occur as a "fluff" material or be compressed into pellets or cubes.

RESOURCE RECOVERY. A term used to describe the extraction of economically useful materials and/or energy from solid waste. Often refers to the burning of waste for energy.

RUNOFF. Any liquid that drains over land from any part of a facility.

RUTGERS STRATEGY. A method of aerated-pile sludge composting developed by Rutgers University. It achieves rapid and thorough decomposition through temperature control and extensive ventilation of the compost piles.

SCREENING. The passing of compost through a screen to remove large inorganic particles and improve the consistency and quality of the end product. Screen types include rotary trommel screens, vibratory deck screens and disc screens.

SCRUBBER. A device for removing unwanted particles from a stream of exhaust air by spraying the air stream with a liquid or forcing the air through a series of baths.

SEPARATION. The sorting of materials in a solid waste stream based on physical or chemical properties. Synonymous with CLASSIFICATION.

SEPTAGE. The solids and liquids removed during periodic maintenance of a septic, aerobic or holding tank.

SEWAGE SLUDGE. The solids and liquids in municipal wastewater which are encountered and concentrated by a wastewater treatment plant.

SHEAR. A type of shredding device.

SHREDDER. A mechanical device used to break up waste materials into small pieces, usually in the form of irregularly shaped strips. Shredding devices include hammermills, shears, drum pulverizers, wet pulpers and rasp mills.

SILO. An enclosed vertical composting vessel resembling a tank or tower. Waste materials are placed in the top and flow downward by gravity. After a period of time, generally 14-21 days, the compost is extracted from the base of the silo.

SIZE REDUCTION. A generic term for breaking up solid waste or other materials into small pieces through crushing, chipping, shredding, grinding, etc. The process makes wastes easier to separate and increases surface area for composting.

SLUDGE. Any solid, semi-solid or liquid waste generated from a municipal, commercial or industrial wastewater treatment plant or water supply treatment plant.

SOIL AMENDMENT/SOIL CONDITIONER. A soil additive which stabilizes the soil, improves its resistance to erosion, increases its permeability to air and water, improves its texture and the resistance of its surface to crusting, makes it easier to cultivate or otherwise improves its quality.

SOLID WASTE. Garbage, refuse and other discarded residential, commercial and industrial waste materials, not including sludge or hazardous waste.

SOURCE SEPARATION. The segregation of such wastes as glass, paper and metal at the point of generation (i.e. the household or office) before they become mixed into the solid waste stream. Source separation makes recycling simpler and easier, and improves the quality of the waste entering a co-composting, RDF or recycling facility. It usually involves educating residents to change their garbage disposal practices.

STABILIZATION. The final decomposition and curing of compost so that it does not reheat when wetted nor give off offensive odors.

STATIC PILE COMPOSTING. A composting method in which the waste materials are laid down in piles on top of perforated pipes. A fan or blower draws air into or out of the piles. No turning is required, as it is in windrow composting.

TIPPING FEE. The price charged for dumping solid waste at a composting, recycling, resource recovery or disposal facility.

TIPPING FLOOR. An enclosed unloading area for vehicles delivering refuse to a disposal facility.

TROMMEL SCREEN. A perforated, rotating horizontal cylinder used in some waste separation systems. As the chamber slowly rotates, the smaller particles of solid waste pass through the perforations. Trommels may be used to break open trash bags and remove glass and small abrasive items such as stones, sand and dirt. Trommels with larger holes can be used to remove containers and other larger objects.

TUB GRINDER. A machine which grinds bulky brush, tree limbs, construction wood waste, pallets, etc. into chips suitable for fuel, landscaping or as a bulking agent for composting.

TURNKEY SYSTEM. A complete, packaged system offered by a single contractor who handles all bidding, design, construction, equipment specification, procurement, etc. The system is then operated by a separate entity.

VOLUME REDUCTION. The processing of waste materials to decrease the amount of space they occupy. Compaction, shredding, composting and burning are all methods of volume reduction.

WHITE GOODS. Discarded kitchen and other large, enameled appliances.

WINDROW. An elongated compost pile, usually about six to 12 feet high and sometimes hundreds of feet long.

WINDROW COMPOSTING. The composting of organic wastes in a series of elongated piles called windrows. The windrows are turned periodically to aerate and mix the waste materials to speed up decomposition and reduce odors.

WINDROW MACHINE. A machine used to aerate and mix material being composted in windrows. The machine travels the length of the windrow and has teeth or augers which shred, break up and mix the material.

YARD WASTE. Garden wastes, leaves, grass clippings, weeds, brush and prunings generated at residential or commercial properties.

COMPOST SYSTEM VENDORS

ABV
PURAC Co.
Compost Engineers and Contractors
Post Office Box 390 A
Santa Clara, CA 95052
Bill Nicholson
(408) 988-3211
    See Purac

Agripost
990 SW First Street
Miami, FL 33130
David J. Smith
(305) 324-8298
    Solid waste/co-composting

American Bioreactor Corp.
700 Century Park S., Suite 202
Birmingham, AL 35226
Mr. Jack O'Brien
(205) 823-5231
    Tunnel system usually used for sludge. Arrangements canbe made for solid waste tunnel system.

American Bio-Tech, Inc.
P.O. Box 19769
Jacksonville, FL 32245-9769
Allen Gray
(904) 724-2424
    Enclosed reactor system, in-vessel composting

Arbios
Avenue Paul Pastur 361
B-6100 Mont-sur-Marchienne
Belgium
071-43 79 34
    Dry anaerobic solid waste composting in an enclosed silo, with collection of methane gas.

NOTE: This is only a partial listing and does not constitute endorsement of services, products or equipment.

Arus Ruthner
Robinson Plaza Three
Pittsburgh, PA 15205
Gene Bergmann
(412) 787-5380
In-vessel co-composting system using a rotating horizontal drum.

Ashbrook-Simon-Hartley
11600 E. Hardy
Houston, TX 77093
John O'Brien
(713) 449-0322
Tunnel reactor, In-vessel composting

Atchinson & Keller, Inc.
1246 Taylor St. N.W.
Washington, D.C. 20011
Roland Kinser
(202) 829-8100
Representative for DANO

Bedminster Bioconversion Corp.
232 Kings Highway East
Haddonfield, NJ 08033
Nelson E. Widell
(609) 795-5767
Solid waste composting (representative for Eweson Digester System).

Biocomp, Inc.
85 Portland Avenue
Bergenfield, NJ 07621
(201) 387-2692

Buhler-Miag, Inc.
1100 Xenium Lane, P.O. Box 9497
Minneapolis, MN 55440-9497
Daniel Kemna
(612) 545-1401
Co-composting systems, waste processing equipment, milling machines. Uses horizontal drum for composting followed by aerated piles.

California Co-composting, Inc.
P.O. Box 10998
Marina Del Ray, CA 90293

Cobey Composting
4250 S.R. 309
Galim, OH 44833
(419) 468-2288
Solid waste composting

Compost Systems Co.
9403 Kenwood Road
Cincinnati, OH 45242
Richard Gossett
(513) 984-0625
In-vessel sludge and solid waste composting systems.
Representative for Paygro and Fairfield systems.

Conversion Control Corp.
402 Park National Bank Building
5353 Wayzata Blvd.
Minneapolis, MN 55416
Glenn Miller
Representative for Eweson Digester.
(612) 544-4492

CREA of U.S.A. Inc.
5415 Manning Place N.W.
P.O. Box 40704
Washington, D.C. 20016
(202) 364-0610
Anders Larkert
Parent Company: PLM-Selbergs

DANO
Horizontal drum co-composting. Unshredded refuse is mixed in drum then placed in aerated piles. See listings for DANO representatives:
- Atchinson & Keller, Inc.
- Reidel Environmental Technologies
- Waste Processing Corporation

Digester Accelerated Decomposition (U.S.A), Inc.
2100 NE Dixie Avenue
Fort Lauderdale, FL 33305
Mike Marinelli
(305) 563-4291
Solid waste/Co-composting

Ebara International Corp.
Hempfield Industrial Park
RR #6, Box 516
Greensburg, PA 15601
(412) 832-1200
In-vessel composting system

Ebara International Corp.
Marubeni American Corp.
200 Park Avenue
New York, N.Y. 10166
Kenneth McFall
(212) 599-3700
In-vessel composting system

EKO-Kompost, Inc.
3700 Compost Road
Missoula, MT 59801
Mr. Joseph C. Horvath
(406) 721-1423

Enviro-Gro Technologies
3700 Koppers Street
Baltimore, MD 21227
Robert Pepperman
(301) 644-9600
Representive for the Ebara in-vessel system.

Eweson Organics, Inc.
232 Kings Highway East
Haddonfield, NJ 08033
Nelson Widell
(609) 795-5767
Eweson Digester in-vessel co-composting system.

Fairfield Service Co.
P.O. Box 354
Marion, OH 43302
Jim Coulson
(614) 387-3335
In-vessel co-composting system.

Fairfield Service Co.
P.O. Box 188
New Castle, DE 19720
Jeffrey Hass, General Manager
(302) 571-8938
In-vessel co-composting system.

Fermentechnik, Inc.
Euramca Ecosystems
40 Fay Avenue, Box 349
Addison, IL 60101

FERRERO, S.P.A.
Officine Meccaniche
PO Box 60
17047 Vado Ligure
Italy
(019) 881951
Horizontal drum co-composting system.

Geophile International, Inc.
P.O. Box 1025
Siloam Springs, AR 72761
Walter Gray
(501) 524-4105

Solid waste and co-composting systems. Wastes are ground in a mill and composted in windrows.

Inge Company, Inc.
One Fields Point Drive
Providence, R.I. 02905
James A. Notarantonio
(401) 461-5700

International Processing Systems
P.O. Box 143
Lebanon, CT 06105
Geoffrey A. Kuter, Ph.D.
(202) 642-6670

Enclosed bin sludge and agricultural composting.

International Recycling Systems
P.O. Box 143
252 U.S. Route 9
Bayville, NJ 08721
(201) 269-8550

In-vessel composting.

Lundell Manufacturing Company
P.O. Box 171
Cherokee, IA 51012

Solid waste composting.

Marubeni
200 Park Avenue
New York, N.Y. 10166
Kenneth I. MacFall
(212) 599-7085

Solid waste/co-composting

Metro-Waste
Resource Conversion Systems, Inc.
9039 Katy Freeway, Suite 300
Houston, TX 77024
Henry Hefty
(713) 461-9228

Microbe Waste Technology, Inc.
818 Summit Bank Building
310 Fourth Avenue South
Minneapolis, MN 55415
Walter Baum, Chairman
(612) 332-1368

Organic Bio-Conversions, Inc.
680 Davis Wells Road
P.O. Box 456
Madisonville, Kentucky 42431
Mark Dingman
(502) 825-1500

OTV
11, Avenue Dubonnet
92407 Courbevoie Cedex
France
Paul Mousty
(1) 774 46 64
Municipal refuse composting system

Parsons Engineered Products, Inc.
P.O. Box 189
Hopkins, MN 55343
Philip W. Parsons
(612) 941-2688 (home)
(612) 933-4134 (office)

Paygro
See Compost Systems Company

Peabody Holmes Limited
Imperial House
Market Street
Huddersfield, England HD1 2HU
0484 40347
In-vessel co-composting in a stationary silo with multiple levels; solid waste processing.

PLM-Selbergs
Greenwich, CT
Leonard Rudman
(203) 661-5285

PLM-Selbergs (Sweden)
P.O. Box 19605
S-10432 Stockholm
Sweden
Int+46-8-15 16 20
Refuse-derived fuel production with windrow composting of organic portion in aerated piles.

Purac Engineering, Inc.
Commonwealth Building, Suite 107
University Office Plaza
Newark, DE 19702
Ake Norin
(302) 737-3355
In-vessel sludge composting system.

Real Earth of Southern California
21048 Devonshire, Suite 210
Chatsworth, CA 91311

Reidel Environmental Technologies
P.O. Box 5007
Portland, OR 97208
1-800-334-0004
Representative for DANO.

Renewable Resource Recovery, Inc.
8105 Perry Highway
Pittsburg, PA 15237
George L. Jones III
(412) 366-4260; (617) 369-3951
David Delporto

Resource Conversion Systems, Inc.
11511 Katy Freeway, Suite 550
Houston, TX 77079
Henry Hefty
(713) 531-9229
Trough digestors for composting municpal refuse.

Reuter Resource Recovery, Inc.
c/o Buhler-Miag or:

11000 West 78th Street #250
Eden Prairie, MN 55344
Daniel W. Silvers, P.E.
(612) 941-7225

Reuter, Inc.
410 - 11th Avenue
Hopkins, MN 55343
(612) 935-6921

Seerdrum
Environmental Utilities Corp.
850 Sligo Ave., Suite 1
Silver Springs, MD 20910
John A. Boyd
(301) 565-2403

Taulman/Weiss Composting Systems
415 E. Paces Ferry Rd., N.E.
P.O. Box 11988
Atlanta, GA 30305
Ron Schuessler, V.P.
(404) 262-2535
In-vessel sludge composting systems.

Tollemache
The Heil Company
3000 W. Montana St., Box 593
Milwaukee, WI 53201
Solid waste composting in aerated bins with mechanical turning.

Parent Company:
Tollemache Ltd.
Misterton, Doncaster
South Yorkshire DNIO 4 DN
United Kingdom
0427/890621

Triga
33 Avenue du Marechal Joffre
92000 Nanterre
France
Composting of ground solid waste in silos.

Ultimate Resources, Inc.
184 County Line Road
Westerville, OH 43081
Marlen Radbill
(614) 890-7649

Waste Processing Corp.
One Appletree Square, Suite 961
Bloomington, MN 55420
Steven Crawford
Representative for DANO and Buhler-Miag co-composting systems.
(612) 854-8666

Water Conservation Systems, Inc.
Damonmill Square, Suite 41a
Concord, MA 01742
1-800-343-1706

Williard Co.
375 Highland Avenue
Jenkinton, PA 19046
(215) 885-5000

WPF Corp.
P.O. Box 381
Bellevue, OH 44811
(419) 483-7752

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